



RECLAIMING THE SHORELINE:

REDEFINING
INDIANA'S
LAKE MICHIGAN
COAST

DANE CARLSON

LANDSCAPE ARCHITECTURE THESIS [2011]

BALL STATE UNIVERSITY

RECLAIMING THE SHORELINE:

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BY: DANE CARLSON

Undergraduate Landscape Architecture Thesis Proposal

Bachelor of Landscape Architecture

Instructors: Burcu Yigit Turan, John Motloch, Chris Marlow

Thesis Advisor: Meg Calkins

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Department of Landscape Architecture
College of Architecture and Planning
Ball State University
Muncie, Indiana

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ABSTRACT

Michigan City's coal generating plant is a blight on the shoreline of Lake Michigan. The plant and its site hamper economic development and ecological processes through toxic industrial process, shoreline modification, and aesthetic degradation. This proposal intends to establish a basis for reclamation of this crucial lakefront site for both community and ecological purposes. Not only will the site act as a vibrant public amenity and destination, but also as a functional environment supporting and creating new ecological growth.

Ecological processes unique to Indiana's Lake Michigan shoreline enjoy vibrant success and support in the Indiana Dunes National Lakeshore to the south. By allowing new dunes to form, thus encouraging inland ecosystem growth, this project introduces an ecological component necessary to establishing a functional environment. Introduction of residential areas allows the site to function as both a destination and place of inhabitation, and, as such, cater to visitors, immediate residents, and residents of surrounding neighborhoods. Amenities not currently possessed by surrounding communities have been provided and walkable access allows all within walking distance to enjoy the site's amenities without the help of an automobile. All of these systems are created within the existing framework of coal generating station infrastructure, and all buildings are reoccupied to maximize reuse of existing features.

Although this site contains many elements, they function as a whole. Ecologically rich forests and beaches are accessible within minutes. Shops allow residents to buy basic necessities in a walkable radius and provide a destination for visitors. The site's core zone, comprised of passive and active recreation zones, is accessible by any and all. A return to ecological functionality is only the beginning: this must be a place in which community and ecology are able to develop simultaneously.

A C K N O W L E D G E M E N T S

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I cannot end without acknowledging the proud and loving memory of my grandfather Robert Christena, alias Bop. His endless fount of knowledge and loving pride in my accomplishments is, and will continue to be, sorely missed. I'll make you proud.

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FIG. 3

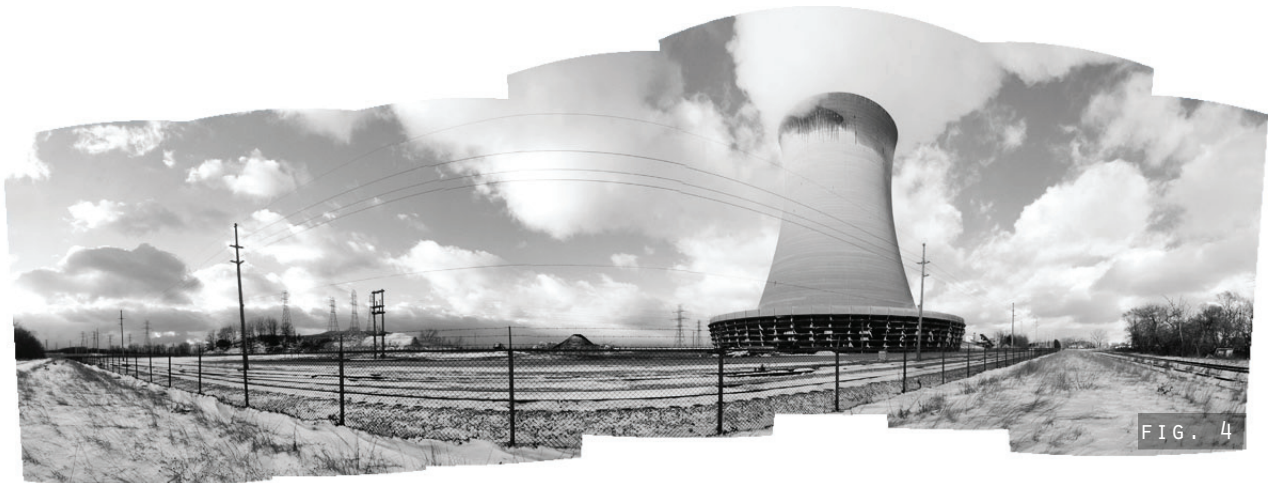


FIG. 4



FIG. 5

INTRODUCTION

Initially developed as a power generating station by the Northern Indiana Public Service Company in the early 1930s, this site has suffered enormously through several phases of development. Byproducts of coal combustion are distributed throughout, potentially mixing heavy metals and other toxins with rain water, which then seeps into the ground. Any ecological community which existed here previously is long forgotten.

To the northeast, the lighthouse jetty of Michigan City's harbor prevents any shoreline to its immediate south from receiving new sediment input. As a result, this shoreline has been subject to massive erosion of existing dunes and destruction of ecological communities. This necessitates the site's shoreline to be stabilized by two layers of steel sheet pilings and large piles of concrete rip-rap. These factors prevent the formation of dunes and healthy ecological communities along the shoreline. Coal ash settling ponds are located adjacent to the lakeshore and are not lined, and a massive pile of coal (up to 150,000 tons) is stored on-site. Both of these features are potentially responsible for groundwater pollution and site degradation.

Neighborhoods surrounding the site fall well below typical standards of education and income. In addition to its aesthetic nuisance, the site is completely enclosed by fences and is inaccessible to any members of the community. Across Trail Creek lies Michigan City's enormously popular public beach, while the location of the plant prevents a massive portion of the shoreline from being used for recreation or other functions.

This site is an integral part of Michigan City's landscape. Not only should it be repurposed gradually for eventual and complete recovery, but it must be regained as a public and ecological amenity in order for the community to grow and develop. A mixture of urban design, ecological introduction, wetland creation, industrial structure reuse, and community development is necessary to establish this space as functional, vibrant, and diverse.

ECOLOGICAL PROCESSES

DUNE FORMATION

Hill, writing a report for Indiana Department of Natural Resources Geological Survey provides information on dune formation specific to the Indiana Dunes State Park. Description of processes involved in dune formation make it clear that any reintroduction of dune ecosystems must be made to evolve over time, especially with accumulation of new sand along the lakeshore as a primary design consideration. The actions of longshore currents sweep beach shores, transporting sediment southwestward along the shoreline (3).

Pioneer vegetation accumulates blowing sand, and as a result embryo dunes are formed. These are the initial stage of foredune development, which result in a ridge of sand 10' high parallel to the existing beach (7). These foredunes actively accumulate sand and eventually are transformed into older foredune ridges, which are subject to a lack of sand accumulation as they become protected by newly accumulated sand structures developing lakeward of them. As has been previously explained, development of foredune complexes protects dune forests and wetlands behind newly developed and developing structures (7). Different plant communities develop behind the foredunes depending on levels of organic matter accumulation, water retention, and the proximity of low points in interdunal areas to existing water levels. The proximity of low elevations in the existing coal ash settling ponds in addition to water retention provided by the landward layer of sheet piling will allow for the creation of damp depressions. These conditions allow for the formation of pannes (interdunal wetlands), which contain some of Indiana's most rare plant life.

Embryo dunes are identified as the initial framework for dune growth through sand accumulation, leading to the growth of foredunes (7). Embryo dunes grow through sand accumulation caused by surface irregularities, and are necessary to begin the cycle of dune development. Components of interdunal areas such as ponds, marshy areas, and unique forms of sand dunes encourage differentiation in vegetative development and are identified as key components of dune ecology beyond the highly visible foredunes (8).

According to Coburn, Griffiths, and Young's Inventory of Coastal Engineering Projects in Coastal National Parks, "the natural pattern of erosion and deposition moves sand in a westward direction along the beaches of INDU (105)." The Indiana Dunes National Lakeshore currently contains 43 coastal engineering projects which severely or completely limit littoral sediment transport. The Michigan City harbor jetty extends over 850' beyond the existing beach, almost entirely eliminating the flow of sediment between the beaches to the east and the national lakeshore to the west. The jetty was first constructed in 1836, so damage caused by the lack of sediment transport has been compounding continuously over a period of almost 170 years. Not only has this resulted in severe shoreline erosion due to the lack of replenishing sand, but has caused the wandering dunes, most notably Mount Baldy, to migrate almost 1000' to the south over the last 60 years. In order for this problem to be alleviated the barrier must be permeated to allow for sediment in the littoral transport zone to flow through and replenish the shoreline to the west.

The NIPSCO generating station site is protected by a sheet piling seawall and concrete rip-rap revetment which, according to NIPSCO's Jeff Neuemeier, were installed in the 1940's and reach downward to the existing sheet of clay at an elevation of 579 (below existing lake level). Sand nourishment has taken place consistently to replenish the beaches of the National Lakeshore, but this solution is flawed at best as it does not repair damaged systems.

According to the Geologic Resources Inventory Scoping Summary, Mount Baldy, one of the Indiana Dunes National Lakeshore's most iconic features, rises over 100' above the surface of the lake. It has been subject to consistent patterns of migration as it moves landward due to lack of new sediment deposition and erosion caused by human interference with site vegetation. Prior to 1938, the dune moved an average of 1.2 meters per year, a number which has increased dramatically through 2005 to 2.7 meters per year south and 2.6 meters per year to the southeast. Mount Baldy is a large parabolic dune, which unlike other layered dune systems running parallel to the beach, is not protected by a system of foredunes and pioneer vegetation. Wind blowing from the lake increases sediment transport up and over the dune, increasing rates of erosion.

According to Bennett, there are several variables which influence rates of sand accretion on foredunes: wind speeds, vegetation cover, ground slope, surface moisture, and sediment source width (1). A consistent source of sediment is also necessary, and is perhaps the most critical component for the accretion of new dunes, and as such is a primary concern for the development of this design.

The author's measurements indicate that "wind speeds were most frequently of low magnitude and from the south or southwest, whereas the largest wind speeds occurred during the northerly winds (9)."

Although a lack of sediment deposition is one of the primary factors of dune erosion, heavy winds are one of the primary causes of dune blowouts, and this aeolian erosion is caused by a lack of stabilizing pioneer vegetation. and fluctuation caused by freeze and thaw of precipitation (19). Because of this, new and existing beaches must be anchored by introduction and growth of pioneer vegetation (primarily beach grass). Landward northerly winds, although less common, have greater potential to cause more erosion because of much greater wind speed magnitudes (9).

Rates of sand accretion are vital to design considerations involving new dune formation as they determine the period of time in which dunes will actually be able to form. According to the author's measurements, during "the 33 month period of monitoring the vast majority of the aeolian deposition along the foredune transect occurred on its lakeward flank; 70 cm of vertical accretion occurred on the lakeward flank of the dune, but only 3 cm of vertical accretion was documented on the foredune crest (17). Based on documentation, it is evident that net sand deposition occurs mainly through late autumn, winter, and early spring partially because of strong northerly winds and fluctuation caused by freeze and thaw of precipitation (19).

SUCCESSIONAL ECOLOGY

Emery and Rudgers provide an assessment of 18 restoration sites on beaches of the Great Lakes (1). Most of these restorations were conducted by installing a monoculture of *Ammophila breviligulata*, a pioneer dune grass which establishes easily and is effective at stabilizing dune structures. However, the study also warns that monocultures lack the ability to support complete ecological community structure; components such as pannes and interdunal ponds create opportunities for plant diversity (1). Several plants are identified as native to dune ecosystems but are much less prolific than *Ammophila* and are identified as typically unable to colonize new dune restorations in spite of introduction of new habitat (6). As these plants are necessary components to a complete ecosystem, they are most appropriately introduced into an emerging dune ecosystem after pioneer grasses begin the process of dune formation.

Egan and Howell provide more insight into establishment of succession through observation analysis of vegetative change in the Indiana Dunes. They identify reports by the earliest ecologists to study the area, who identify the initial pioneer species as previously identified *Ammophila breviligulata* and *Populus deltoides*, eastern cottonwood (393). These communities transition to jack pine and eastern white pine, and then to black oak, white oak, and prairie species (393). This description of the evolution of coastal ecologies identifies a process of restoration which can advance inland from pioneer to oak, simulating the already present and evolving strata of dune ecosystems. Some of the species that at one point formed vital pillars of successional ecosystems have been irreversibly degraded by a combination of human habitation and deer overpopulation, most notably the eastern white pine (405). Reintroduction of this species into the pine dune stage would necessitate the introduction of features to protect newly growing white pines from rampant deer populations, while allowing small species such as squirrels and chipmunks to access the trees and habitat contained within.

AQUATIC HABITAT

Wei, Chow-Fraser, and Albert provide a logical basis for development of necessary coastal habitats to provide fish habitat, which are “used in excess of their availability (9).” The concept of designing a complete ecosystem includes not only terrestrial systems, but also aquatic systems, which can be directly benefitted through development of coastal features. The study identifies the three most common shoreline habitats for fish as bedrock, wetlands, and sandy beaches/dunes (5). The article also identifies three distinct group of fish taxa, or groups that primarily utilize different coastal features (9). Because of the lack of significant amounts of shoreline aquatic habitat introduced by coastal wetlands, in combination with the differing needs of various fish taxa, introduction of these features must include a variety of wetland and beach types to accommodate more than one group of fish species, providing for the greatest possible amount of biodiversity.

Albert, Ingram, Thompson, and Wilcox provide an introduction on coastal wetlands of the Great Lakes which identifies patterns in development of fish and wildlife habitat through introduction of environmental systems. The report identifies three principal kinds of coastal wetlands of the Great Lakes: lacustrine, or those systems directly exposed to onshore forces, riverine, or those occurring in rivers or creeks, and barrier-protected, those which are separated from the Great Lakes by a barrier feature (1). A type of riverine wetland named Barred, Browned River-Mouth wetland is formed through the accumulation of a sediment barrier at the mouth of a channel, forming a lagoon which can support most of the wetlands’ vegetation (4).

According to Albert, the introduction of a coastal wetland depends largely on protecting the wetland from the fluctuations of the nearby lake, primarily violent littoral currents and stormdriven waves (8). Barrier protected wetlands depend on a barrier which protects vegetative systems of the wetland from waves and violent currents while allowing lake water to flow to and from the waters of the wetland (8). These wetlands are also be protected by a foredune which limit the aeolian impacts of wind coming from the lake (8). The landward portion of these barriers supports unique emergent vegetation in addition to that vegetation introduced into the interior wetland system (12).

Like all other components of successional dune landscapes, vegetative components of the wetland form in distinct layers. According to Albert, coastal wetlands typically include a submergent marsh, emergent marsh, shrub swamp/wet meadow, and cedar swamp (18). A protected embayment wetland in Duck Bay includes several of these zones: the submergent marsh inhabits the first 1000' inland from the shoreline, the wet meadow 1000' to 1700' inland, and the white cedar swamp 1600'-1800' inland (18). Introduction of this coastal wetland will include creation of these valuable vegetative communities which will become a component of the larger site ecosystem. They will, however, be compressed to fit within the confines of the site because of the need to incorporate all of these zones to create a functional and educational landscape.

These articles identify key components of dune ecosystems and elements integral to their formation. Key findings include the necessity of introduction of a pioneer grass species to stabilize dunes, either existing or constructed. These dune grasses, while an important part of dune ecosystems, should not be allowed to establish a complete monoculture because of the limitations this imposes on other forms of plant life. Phasing is necessary for introduction of dune ecosystems because of this.

Not only is terrestrial habitat and diversity valuable, but also aquatic, and features of the site design on land will allow for increased aquatic habitat. Perhaps design elements can even be envisioned to create new habitat under the water's surface. Dune ecology extends far beyond the initial face of the foredune, but includes various plant communities including pine dunes, oak dunes, and beach/maple dunes, all of which are vitally important to development of a complete dune ecosystem. This information must be supplemented by further exploration of existing conditions at the project site to determine where certain methods are most appropriate, as well as where existing ecosystems can be complemented by introduced systems.

Waterfront development for public use has ecological ramifications which can be properly prepared for through design. Citta D'Aqua defines waterfronts as long term projects, and long term development is also integral to establishment of dune and wetland ecosystems (www.citiesonwater.com).

COAL PLANT WASTE MANAGEMENT AND POTENTIAL REMEDIATION METHODS

COAL BYPRODUCTS

Fly ash disposal perhaps has the most widespread environmental effects of any process included in coal byproduct disposal excluding those gases released into the air. All coal plants traditionally incorporate one or more large settling pond to gather coal ash. A slurry mix of coal ash and water is pumped into these ponds, allowing for coal ash suspended in the slurry to settle at the bottom of the ponds, which are drained and then harvested. Hardy's report on the environmental effects of coal ash settling ponds asserts that coal ash settling ponds have had harmful environmental effects on the Indiana Dunes National Lakeshore area, specifically concerning introduction of trace elements into ground and surface water (9). The report also states that concentrations of dissolved solids are higher in settling ponds than in surrounding water bodies, meaning that these require more concentrated rehabilitation efforts (30). Some of the elements found in these deposits, such as aluminum, arsenic, cobalt, and lead are sometimes found in concentrations that exceed levels mandated by EPA control (38).

One of the most obvious design implications is the necessity to separate the ash settling process from the ground and various ecological components associated therewith. Because of the groundwater contamination caused by these settling ponds, separating the settling apparatus from the ground would eliminate this problem largely if not altogether. Removal of the most contaminated soils directly underneath and adjacent to fly ash settling pools can be removed and treated separately. Alternative methods include phytoremediation; in one case study, poplar trees were used to intercept contaminated groundwater before it spread beyond the project site, thereby spreading the contamination beyond treatable bounds (Kirkwood, 36).

Solid waste byproducts from the coal combustion process include slag and bottom ash, fly ash, and scrubber sledge, and Dvorak says "impacts to terrestrial and aquatic environments arise during and after disposal of these wastes, specifically due to the physical quantity and chemical quality of these wastes (40)": fly ash is likely the most heavily used byproduct of these processes, and 70-80% of ash production is fly ash (29). Most of the alternative uses for these byproducts are typically related to construction or landscape development: slag is often used for fill or blasting material while fly ash is well known for its applications as a cementitious material. Bottom ash is often used for road base, subbase, or structural fill, and as such would also be extraordinarily useful in site construction as development of hardscape circulation networks. Use of settling ponds for storage and settling can be environmentally harmful as they sometimes attract waterfowl due to development of some vegetative communities, which then ingest harmful doses of particulates and chemicals (110). According to NIPSCO's Jeff Neumeier, NIPSCO's Michigan City generating station only harvests the fly ash in the on-site settling ponds every 20 years or so. This is largely because, says Mr. Neumeier, the plant is able to harvest 95% of produced coal ash directly from the air.

ENVIRONMENTAL IMPACTS

Dvorak's book, which chronicles the environmental effects of coal power production, identifies features harmful to fish and wildlife as coal slurry pipelines, coal cleaning and storage, ash, and desulfurization sludge, excluding particulate emissions (iii). Coal storage areas are included in every coal plant design, as they are required to hold enough coal in reserve to ensure supply in case of interruption of coal shipments (28). According to Jeff Neumeier, the generating station consumes over 5,000 tons of coal a day, meaning that the site's one month reserve pile contains over 150,000 tons. One of the most important problems with coal storage is oxidation: as coal in storage piles come into contact with circulating air, there is potential for the piles to spontaneously combust, assuming the accumulation of a large enough pile. Stockpiles can be divided into smaller piles, but this means that more surface area is exposed for oxidation of coal stockpiles (28).

The danger of coal reserve combustion can possibly be combated by new methods of coal storage which compartmentalize coal piles into a larger structure which limits air flow through coal piles; this would also release the ground plane from contamination by these large coal piles. Another side effect of coal storage is generation of airborne particulates which dusts surrounding vegetation, harming it and related ecological systems by retarding vegetative growth and making plants less desirable for animals as a food source (17).

The environmental impacts of coal storage piles extend beyond terrestrial impacts; aquatic systems are effected similarly. Surface runoff from coal piles carries with it trace elements, minerals, and particulate matter which can severely damage aquatic systems (55). As the Michigan City generating plant is located directly on Lake Michigan, aquatic systems are a dire concern for this site design as aquatic ecology is equally important as terrestrial ecology. Part of the environmental phasing plan of the site design should include a temporary tiered buffer system which would catch runoff from coal storage and refuse piles before they are able to run into large surface bodies of water.

Information concerning chemical properties of coal combustion byproducts, as well as seepage caused by coal pile placement, makes it seem obvious that ash settling ponds and coal storage yards must be removed and their soil rehabilitated separately for reintroduction of sensitive ecologies. Although terrestrial impacts of coal combustion plants are not as high as damage caused by airborne pollutants or coal mining operations, the damage caused by the placement of this plant in an environmentally sensitive location has been irreversible, and the most effective way to rehabilitate the site is to gradually remove the processes from the land, and finally the plant itself from the land.

COMMUNITY DEVELOPMENT

COMPONENTS OF SUSTAINABLE COMMUNITIES

Edwards and Turrent indicate that sustainability in development of residential areas must address several primary concerns: “the conservation of natural resources (land, energy, water), the sensible re-use of man-made resources, maintenance of ecosystems and their regenerative potential, equity between generations, people, and classes, and provision of health, safety and security (20). The need for density dictates a majority, if not all, housing to be designed in buildings containing multiple units. Citta D’Aqua identifies mixed use as a priority for waterfront development which is also a viable component of high density development (www.citiesonwater.com). Edwards and Turrent discuss architectural design, indicating that home types with the least amount of energy lost are those located between two other units (either vertically or horizontally sandwiched), and those which are the least energy efficient being detached single family homes (20). The authors also specify that it is necessary to consider in a holistic fashion the “environmental resource implications of their developmental decisions (29).”

One of the principles of sustainable housing design described by Edwards and Turrent is the integration of transportation planning in concert with land use (30). Open space is also a primary principle for sustainable housing design; the authors state that public and open space should be used for promoting social interaction and ecological wellbeing, therefore identifying open space as a potential catalyst for community-building within the physical environment of the place (30). The connection of open space to ecological wellbeing allows central spaces to become bridges between ecology and community by introducing people into “outdoor” environments. At Hammarby Sjostad, a new community on Stockholm’s waterfront, integration of ecology and urban is accomplished through integration of vegetative and water systems into the interior of the development. This is perhaps most notable in the Reed Park, where residents and visitors can explore the shoreline on a series of elevated boardwalks (Andersson, 6).

WATERFRONT DESIGN

According to Worpole, the design of urban waterfront promenades has been integral in reviving pedestrian and cycling activity in modern cities (22). Boats are also an important component of waterfront access, and Venice’s Citta D’Aqua lists “Public Access is a Prerequisite” as one of its ten primary criteria for successful waterfront design (www.citiesonwater.com). Andersson identifies one of the primary successes of Hammarby Sjostad as accessibility through water in addition to pedestrian accessibility (5). Hammarby Sjostad places public space in close proximity to the water as a network of quays, promenades, and viewpoints (Andersson, 6). This again meets the Citta D’Aqua criteria concerning public access. Concerning Melbourne’s waterfront, Sandercock and Dovey identify the areas of least successful development as those lacking public access, while those areas with a food court and seating on the ground floor were responsible for the creation of a diverse clientele on the water’s edge (156, 157). The organization of waterfront features at Hammarby Sjostad meets another of Citta D’Aqua’s criteria, which states that “Waterfronts are part of the existing urban fabric (www.citiesonwater.com).”

DEFINITIONS, DELIMITATIONS, AND ASSUMPTIONS

DEFINITIONS

COAL COMBUSTION BYPRODUCTS (OBJECT):
variety of materials produced by burning coal in power plants which are typically not utilized on or off-site for reuse purposes

DUNE ECOLOGY (PROCESS):
network of plant and animal communities created and sustained within successional dune environments

INTERDUNAL AREA (FORM):
area formed in depressions between two sand dunes

MONOCULTURE (PLANT COMMUNITY):
area inhabited by only one plant species; monocultures often stifle ecological diversity in said location

NIPSCO (ORGANIZATION):
Northern Indiana Public Service Company, a public utility provider in northern Indiana which operates the Michigan City generating station

PIONEER (PLANT):
Plants which initially colonize barren land, forming the initial stage of plant colonization and vegetative system development

RIP-RAP (OBJECT):
Large concrete blocks which aid in reducing the turbulence of wind driven waves as they impact a shoreline

SHEET PILING (OBJECT):
Interconnected steel sheets which, when driven into the ground, form a barrier preventing erosion or other natural phenomena

SUCCESSION (PROCESS):
stages of ecological progression which result in gradual and constant change of the dominant vegetative/animalian typology

DELIMITATIONS

- Specific studies of all on-site structures for re-use will not be included in this project.
- Decontamination methods will be discussed and investigated, but comprehensive strategies for decontamination will not be included.
- Restoration of ecological habitat will be discussed in this project, although planting plans will not be included for much of the design.
- This study will not include project funding.
- This study will not explore design strategies for neighborhood development beyond proposed community design.

ASSUMPTIONS

- All construction on site will comply with county, municipal, and other building codes and ordinances.
- Remediation efforts included as initial project phases will be successful in removing the majority of ground contaminants as a basis for further design development.
- NIPSCO's Michigan City generating plant will be decommissioned in the future in favor of development of renewable energy technologies.

SIGNIFICANCE & GOALS

As the power and affordability of renewable energy rises, coal plants such as this one become relics of yesteryear. This does not mean, however, that the heritage of the fires of industry must be forgotten, but instead remembered as a pivotal stage in world history. This project not only intends to reclaim this site from coal power, but also to recognize the historical importance of industry and fossil fuels by utilizing existing structures to create something new.

Given the number of industrial sites on Lake Michigan's southern shore, this project also has the potential to act as a catalyst for reclamation of other lakeshore sites. Many of these sites have been polluted through multiple means, and strategies of remediation must be developed beyond soil removal and groundwater pumping by eliminating pollution at the source.

Although these industrial sites once hosted only dune forests and beaches, they are also the one of the region's most popular destinations because of their proximity to the waterfront. Because of this, it is necessary to investigate methods for ecologically responsible inclusion of human activity and inhabitation. To claim waterfront sites solely for ecological restoration is to ignore peoples' desire to be near water and beaches. The site's Trail Creek waterfront has great potential for development as a public waterfront because of its proximity to Franklin Street, and because of this has the potential to revitalize Michigan City's old retail district.

The industrialization of this shoreline has led to the destruction or degradation of vast amounts of beaches, dunes, forests, and wetlands. This project intends to establish methods for creative reestablishment of ecological zones without permanent deformation of the landscape, allowing these systems to evolve gradually. In this and many other regards, this design will act as a prototype for future restoration and growth.

1. *ESTABLISH A FRAMEWORK FOR GRADUAL **ECOLOGICAL DEVELOPMENT***
2. *USE EXISTING SETTLING PONDS AS A FRAMEWORK FOR **WETLAND DEVELOPMENT***
3. *CREATE A PLACE FOR RESPONSIBLE **HUMAN INHABITATION** INCLUDING BOTH RESIDENTS AND VISITORS*
4. *PROVIDE RESIDENTS WITH ACCESS TO **ECOLOGICAL AND RECREATIONAL AREAS***
5. *UTILIZE EXISTING STRUCTURES FOR RECREATION, COMMUNITY, AND COMMERCIAL PURPOSES*
6. *CREATE A VIBRANT AND ACCESSIBLE **PUBLIC WATERFRONT** ALONG TRAIL CREEK*
7. *PROVIDE **ACCESS TO THE EXISTING BEACH AREA** ON THE CONFLUENCE OF TRAIL CREEK AND LAKE MICHIGAN*

CLIENT & PROGRAM

This site is designed to accomodate four user groups: new site inhabitants, residents of existing neighborhoods, residents of Michigan City proper, and seasonal tourists. Instead of creating a place for only one group, each is incorporated through multiple amenities and site features which also allow for harmonious cohabitation of user groups.

PROVIDE DIVERSE OPPORTUNITIES FOR RECREATION

PASSIVE AND ACTIVE RECREATION
YEAR-ROUND RECREATIONAL ACTIVITIES
REUSE OF BOTH BOILER HOUSES FOR INDOOR SPORT AND
ADVENTURE RECREATION FACILITIES
PUBLIC BEACH ALONG SHORELINE
EVENTS LAWN AND SLEDDING RUN

CREATE DYNAMIC PUBLIC SPACE NETWORK

BOTH LARGE AND SMALL SPATIAL DEVELOPMENT
LUSH PLANTINGS AND STORMWATER INFILTRATION CAPACITY
QUICKLY ACCESSIBLE FROM ANYWHERE ON SITE
UTILIZE INDUSTRIAL INFRASTRUCTURE AS SPATIAL FRAMEWORK

PROVIDE DENSE AND DIVERSE RESIDENTIAL DEVELOPMENT

RANGE OF DENSITIES
EXTENSIVE AERIAL COURTYARD ACCESS SYSTEM
QUICK ACCESS TO PRIVATE AND PUBLIC SPACE
WALKABLE AMENITIES (LAUNDROMAT, GROCERY, ETC.)

CREATE FRAMEWORK FOR ECOLOGICAL DEVELOPMENT

DUNE ACCUMULATION STRUCTURES
REPRESENTATIVE FOREST STRATA
INTERDUNAL AND COASTAL WETLANDS

CASE STUDIES

Post-industrial reclamation projects have enjoyed massive popularity through many design fields in recent years. The desire to create a tabula rasa for site development has been replaced with reserved celebration of site history and character while remediating and repurposing.

Several flagship reclamation projects, Duisburg Nord Landscape Park and Ballast Point Park (shown), in addition to Seattle's GasWorks Park have inspired a multitude of reclamation projects throughout the world. Responsible residential design in harmony with nature has also risen to the forefront of architecture and landscape architecture, and Stockholm's Hammarby Sjostad is one of the most striking contemporary examples of this.



FIG. 6



FIG. 7

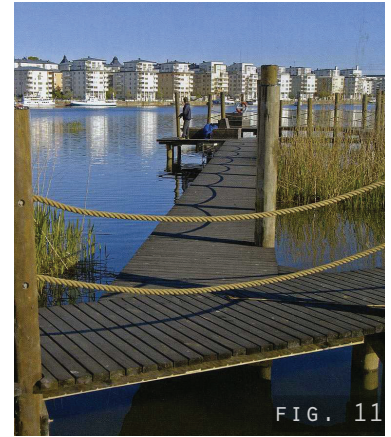


FIG. 8

DUISBURG NORD LANDSCAPE PARK: DUISBURG NORD, GERMANY

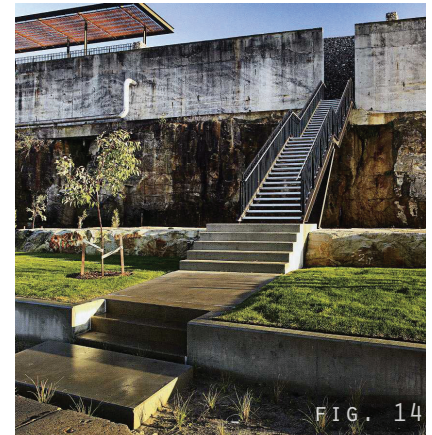
The flagship project of post-industrial reclamation, Duisburg Nord Landscape Park incorporates garden design, remediation, and recreation. Widely known as a landmark site, reuse of existing site features is a consistent theme in

the project. A gas storage tank functions as a scuba tank and mineral storage bunkers are transformed into climbing walls. The integration of small, lush greenspaces incorporate intimate spatial destinations within the framework of the large reclamation plan (Weilacher).



HAMMARBY SJÖSTAD: STOCKHOLM, SWEDEN

Drawing many parallels to the NIPSCO generating station site, Hammarby Sjöstad treats water and ecology in a unique way. Green and blue function as the main public space and circulation routes, and most residential units have a direct view of the water or greenspace (Andersson).



BALLAST POINT PARK: SYDNEY, AUSTRALIA

This project is notable for its thorough reuse of existing structures and materials. Recognition of past industrial heritage is apparent as historic steel and concrete are bridged by new site elements. Because of its geographic location on a peninsula, this project is a visual

and figurative beacon for brownfield reclamation awareness. The site is not forced into a multitude of programs, but rather the industrial framework forms a series of large unprogrammed spaces (Hawken).

INVENTORY AND ANALYSIS

Michigan City's NIPSCO generating station site was once home to the Hoosier Slide, the largest sand dune in the dunes lakeshore system. Once a popular civic and tourist attraction, the Hoosier Slide's proximity to Trail Creek made it vulnerable to development and sand mining. Eventually, the Hoosier Slide was completely destroyed by mining activities and a vital ecological and cultural resource was irretrievably lost.

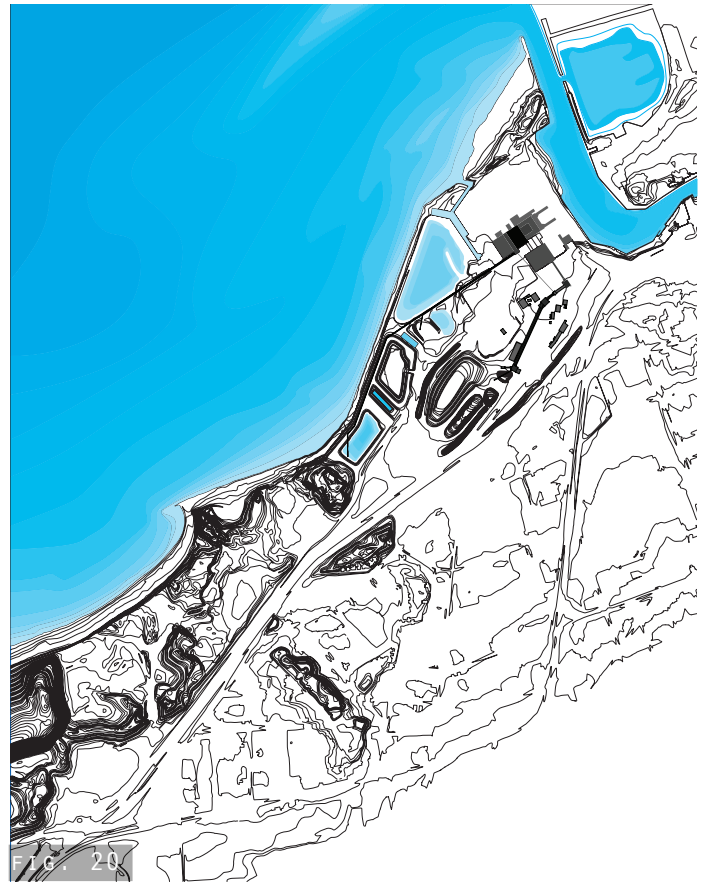
As can be seen in the figure ground, the site only hosts a handful of structures and infrastructure components. Most of the 100+ acres are used for coal storage and coal ash settling ponds, two activities detrimental to ecological function. Although heavily graded to allow for industrial function, the site still maintains significant topography, perhaps most notably on the beach to the north.





EXISTING FIGURE GROUND
(ARCHITECTURE + INFRASTRUCTURE)

While the plant occupies the northern stretch of shoreline shown, the ecologically diverse Indiana Dunes National Lakeshore lies directly southwest. The neighborhood to the south consists entirely of single family homes in generally poor repair which lie between the generating station and the Indiana State Prison farther south. Michigan City's Premium Outlets Lighthouse Place outlet mall forms the cluster of large buildings directly to the south. To the south of the outlet mall, the downtown area forms the much more dense residential core of Michigan City. Much of the town's residential density is far removed from the lake, so creating new areas of density closer to the water will establish a new, positive trend of residential density and ecological function.



EXISTING TOPOGRAPHY/BATHYMETRY
(TWO FOOT CONTOUR INTERVALS)

Much of the site's existing topography is artificial. The central coal pile, over 40 feet in height, lies at the center of a series of constructed berms which obscure the pile from public view. The shoreline elevation falls rapidly to the water due to the sheet pile and rip-rap wall which prevents the collapse of the ash settling ponds bordering the lake. While Michigan City's topography is typically flat and unnoticeable, the Indiana Dunes maintains an abundance of topographic variety. The creation of new dunes along the generating station shoreline will in turn lead to the creation of a topographically diverse shoreline.

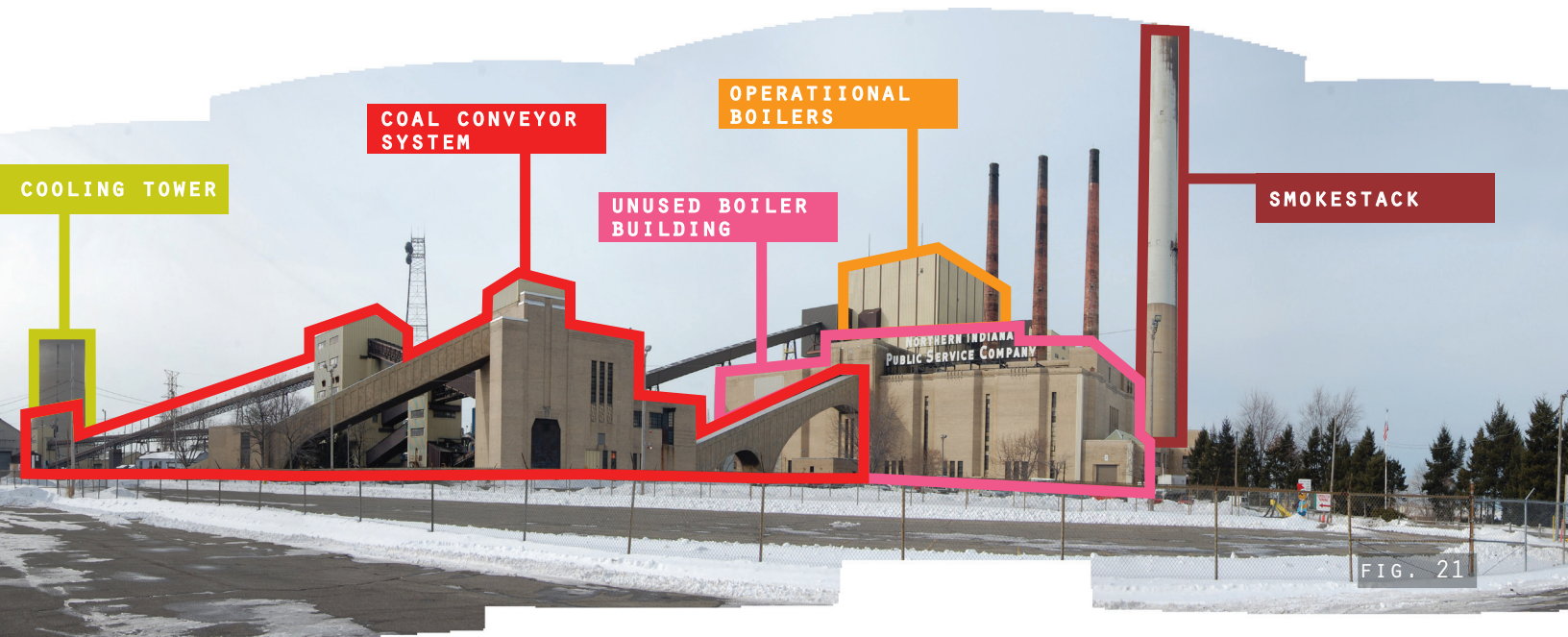


FIG. 21

PLANT & STRUCTURES

The blonde brick boiler house, in addition to the brick coal conveyors, was the first architectural component of the NIPSCO generating station. Built in the mid-1930s, this structure now sits unused. The current boiler house, coil conveyors, smokestack, and cooling tower were constructed in the early 1970's and are now responsible for all coal burning, transport, and power production on this site.

Each existing structure is a primary concern in design evolution because of the potential for programmatic and structural reuse. Reuse will allow for conservation of resources and thorough recognition of the site's transformation from industrial wasteland to functional and vibrant space.





FIG. 22



FIG. 23

COAL ASH
PIPELINE

SHEET PILING/
RIP-RAP



FIG. 24

SECONDARY
SETTLING POND

SHORELINE INFRASTRUCTURE

Over 1.5 miles of steel sheet piling maintain the engineered shoreline of the plant. Driven into the soil in the 1940's, it is generally understood that these are driven into a clay layer at 579 sea level elevation, but further details are unavailable. Rip-rap and accropode enforce this barrier, preventing eolian sediment migration and vegetative growth.

Coal ash slurry is sent to the settling ponds through a pipeline which transverses much of the plant's shoreline, emptying into three of the five settling ponds and one boiler slag pile. The settling ponds are designed in series, the primary pond being the southernmost. These ponds, as of January 2011, have not been emptied since 1990 and contain coal ash up to 25' thick. According to NiSource's Jeff Neumeier, they are also unlined and sit on beds of permeable Tolleston beach sand.



SITE OBSERVATION

In January of 2011 I participated in a site tour of NIPSCO's Michigan City generating station given by Jeff Neumeier, the program leader for environment, health, and safety at NiSource.

Mr. Neumeier and I began at the generating station's main parking lot and proceeded up the eastern shore of the generating station on Trail Creek. He noted that the primary water intake for the plant is located along this sheet pile wall. We then proceeded to the largely empty area directly north of the boiler house, which has few permanent infrastructure components and, as seen on the site topographic map, is almost entirely level.

The discharge channel is located directly to the east of this area and is responsible for the daily discharge of up to twelve million gallons of water into the lake. Before discharge, the water is cooled in the large cooling tower to the southwest and pumped back toward the lake. As we approached the first sheet pile wall (which forms the first layer of the shoreline embankment), Mr. Neumeier noted that the sheet pilings had been driven almost 70 years prior and as such it is almost impossible to accurately determine their depth. He was, however, able to speculate that the pilings had likely been driven into a sheet of subgrade clay. It was noted that because the sheet piling and subterranean clay layer form a barrier at this point, groundwater from the generating station site cannot enter the lake.

This is very fortunate given the condition of the series of coal ash settling ponds and coal storage piles on site, none of which, according to Mr. Neumeier, are lined to prevent infiltration of heavy metals and other contaminants. As noted previously in the review of literature, several sources identify runoff from coal piles and settling ponds as harmful to ecological systems.

We then proceeded southwest as Mr. Neumeier noted the pipeline which carries the coal ash slurry from the boiler house to the series of settling ponds. This slurry of water and coal ash only accounts for 5% of harvested ash, as the other 95% is captured within the plant in dry form. According to Mr. Neumeier, the primary ash settling pond (located the farthest southwest) contains up to 25 feet of ash accumulation and has not been emptied since 1990.

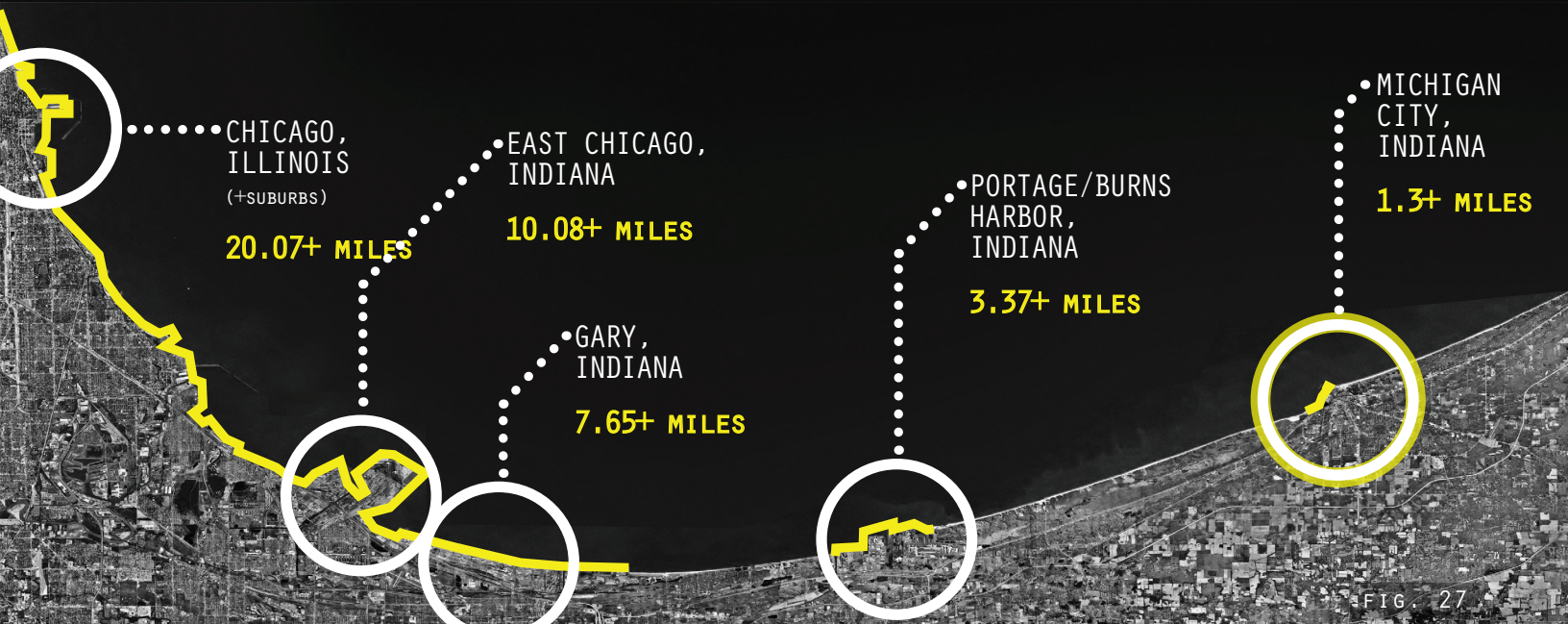


FIG. 25



FIG. 26

THE PROBLEM



CONSTRUCTED AND MODIFIED SHORELINES

One of this project's primary goals is the reestablishment of ecological systems not only on this particular site, but also along the entire southern shore of Lake Michigan. From Gary northward to Chicago and beyond, these shores have long been host to some of the nation's heaviest industries. These have in turn led to the channelization of rivers, rebuilding of shorelines, and the restriction of sediment flow. These all pose major problems to ecological systems function in the sensitive and unique dune ecosystems. Mount Baldy, the Indiana Dunes National Lakeshore's tallest dune, has eroded almost 1000' southward over the last 70 years. This project proposes a solution which can be applied to any of these integral sites.

PRIVATE OWNERSHIP

Sited on the confluence of Trail Creek and Lake Michigan with close proximity to historic Franklin St., this site is perfectly poised for extensive public use. However, private ownership ensures that none of the property is usable by the public.

SEDIMENT BARRIER

Michigan City's harbor jetty has been the cause of massive erosion in Indiana's dune systems since its initial construction in the 1830s. With this barrier in place, sediment cannot flow along the shoreline and create new dunes.

DETRIMENTAL AESTHETIC

The neighborhood to the south of the site has unusually low education and household income rates. It is likely that this is because the neighborhood is sited between the NIPSCO generating station and the Indiana State Prison.

POLLUTED SOIL/GROUNDWATER

Coal ash and boiler slag storage in the sandy soil has likely contributed some degree of contamination to groundwater and soil on site.

ECOLOGICALLY BARREN

The site occupies a vital junction between the Indiana Dunes National Lakeshore and a long string of dunes and beaches which stretch northward, but is not able to support any ecological function.

FIG. 28

OPPORTUNITIES & CONSTRAINTS

MICHIGAN CITY JETTY

ELIMINATES NATURAL
SEDIMENT FLOW

WASHINGTON PARK/MARINA

POPULAR SUMMER AMENITIES
FOR LOCALS (INCLUDES ZOO
AND PUBLIC BEACH)

FRANKLIN ST.

HISTORIC DOWNTOWN
DISTRICT

GENERATING STATION

POLLUTES AIR, GROUND,
AND WATER; POTENTIAL
FOR REUSE

ASH SETTLING PONDS

POLLUTES AIR, GROUND,
AND WATER; POTENTIAL
FOR REUSE

HIGHWAY 12

VEHICULAR BARRIER
LIMITING ACCESS OF
NEARBY RESIDENTS TO SITE

INDIANA DUNES LAKESHORE

ECOLOGICALLY FUNCTIONAL
SHORELINE EXISTS JUST
BEYOND SITE BOUNDS

EXISTING NEIGHBORHOOD

LIGHTHOUSE OUTLET MALL

POPULAR DESTINATION FOR
TOURISTS AND LOCALS

FIG. 29

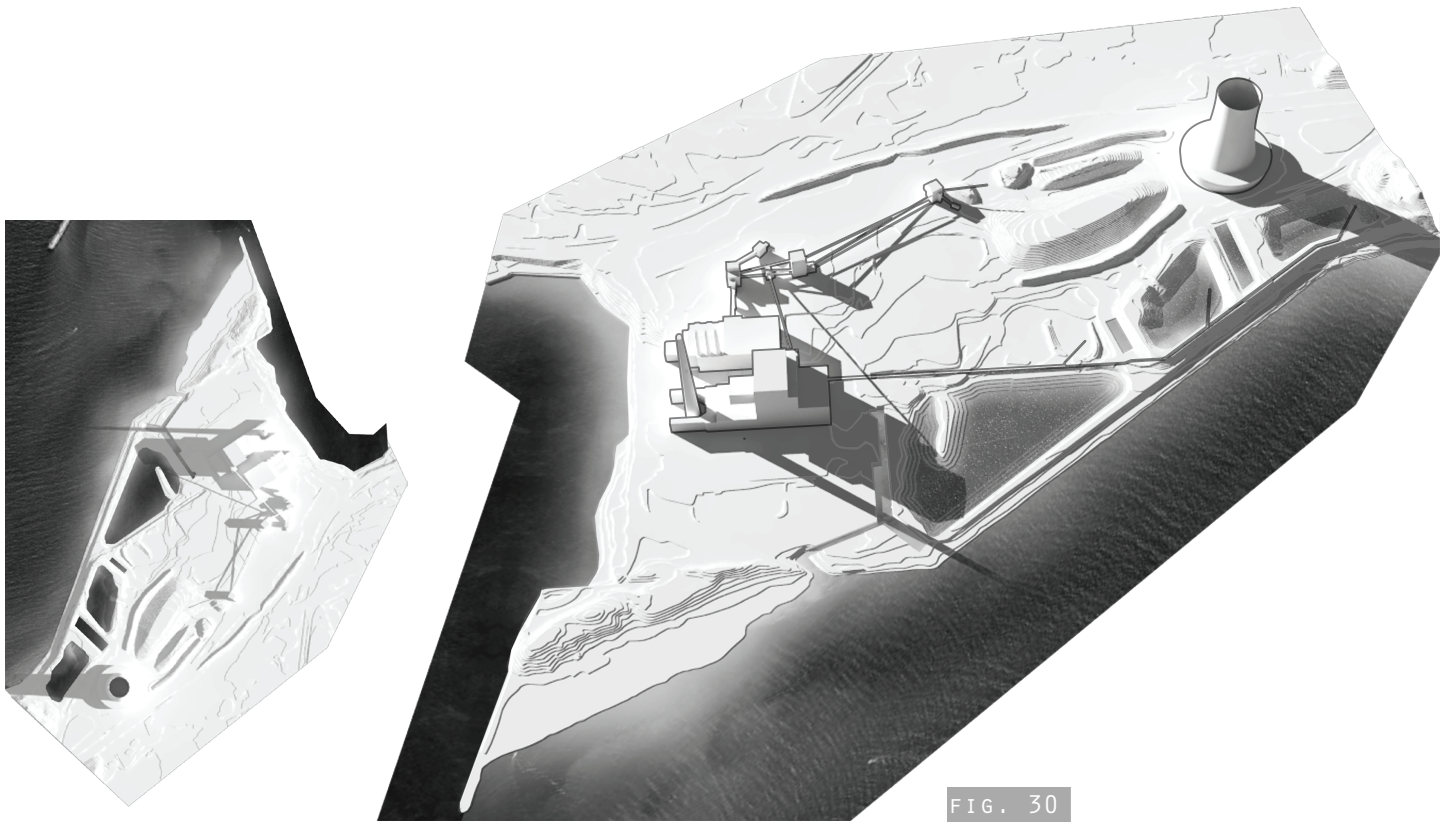


FIG. 30

SITE PLAN/AERIAL
(EXISTING CONDITIONS)

CONCEPTS & SITE DESIGN

Conceptual development primarily involved extension of contextual elements into the site rather than the creation of an entirely new program. As surrounding neighborhoods, beaches, and commercial areas were deemed to be among the most pertinent nearby site features, the design process intended to strengthen and continue connections.

RESIDENTIAL

Residential development on site is primarily designed around two existing elements: the neighborhood to the south and power plant infrastructure. Instead of creating a separate residential enclave, decreasing residential density on the site's southern perimeter provides greater open/pedestrian space along Highway 12. Pedestrian access from north to south occurs across the now narrowed road.

Power plant infrastructure, namely coal conveyors and towers, form the spine of residential development. They act as the center of an aerial access system which spreads to the plant buildings, woodland, and cooling tower hotel.

E C O L O G Y

Beach, forest, and wetland development are the three principal elements of the ecological evolution strategy. Reconfiguration of the Michigan City jetty allows for littoral sediment drift, and the deconstructed shoreline of the site allows for settlement of sand and development of beaches.

All coal ash settling ponds are transformed into interdunal and coastal wetlands, providing habitat for some of Indiana's most unique plant life. Forest becomes a vital part of site character and organization as a band of jack pine and oak forest stretches from east to west.

COMMERCIAL

Franklin St.'s commercial corridor to the south is extended northward, creating a pedestrian connection to Michigan City's historic core. The shoreline of Trail Creek becomes a vibrant pedestrian space for shopping, eating, and seeing and shops are located in the lower stories of both boiler houses.

Small commercial opportunities, primarily those providing necessary services such as grocery, daycare, and laundromat for residents, extend inward along the coal conveyor spine.



=



=



=



FIG. 31

CONCEPTUAL CONSIDERATIONS

The site, although bounded by many geographic limitations, occupies a strategic location within the greater context of Michigan City, Trail Creek, and the southern shore. Many design considerations extend beyond the site to integrate it into this context.

Indeed, much of the site's program is determined by infiltration of existing land uses and associated necessities. Franklin St.'s proximity to the eastern shore makes the location of the commercial zone on this portion of the site a logical extension of existing circumstances.

Shown are conceptual considerations that extend beyond the scope of detailed site design and, while not specifically designed, are critical to the site's long term development and success.

PERMEATED JETTY

Michigan City's jetty blocks all littoral drift and prevents migration of new sediment downshore. Through reconfiguration of the jetty into a permeable structure which would still maintain the safe waters of the harbor, sand will be able to migrate southward through wind and wave action.

LONGSHORE CURRENT

As coal ash and boiler slag can be used as cementitious material and aggregate for concrete manufacture, byproducts produced at the generating station will be made into concrete at a plant directly south of the site.

FIG. 32



CREEK DEVELOPMENT

The majority of the banks of Trail Creek are either privately owned or occupied by abandoned industrial complexes. As an extension of the site's commercial development and public waterfront, the entire shoreline of Trail Creek will be redeveloped as a continuous public waterfront.

UNIFIED SHORELINE

As coal ash and boiler slag can be used as cementitious material and aggregate for concrete manufacture, byproducts produced at the generating station will be made into concrete at a plant directly south of the site.

CONCRETE MIXING

As coal ash and boiler slag can be used as cementitious material and aggregate for concrete manufacture, byproducts produced at the generating station will be made into concrete at a plant directly south of the site.

FRANKLIN ST. RETAIL

The retail area/public waterfront will extend east and south to connect to historic Franklin St. This will establish a retail corridor and invigorate Franklin St.'s underutilized storefronts.



EXISTING COAL ASH/ BOILER SLAG
SETTLING PONDS:

450,000 + SQUARE FT.

THESE PONDS ARE EMPTIED ONLY
ONCE EVERY TWENTY + YEARS;
CURRENTLY THE PRIMARY ASH
SETTLING POND CONTAINS AN
ASH DEPOSIT UP TO 25' THICK.

REMEDIATION

The initial step of project development must be remediation. To combat soil and groundwater pollution, coal ash and boiler slag cannot be stored in the ground, but instead can be lifted above the ground plane.

Creation of a series of above ground settling basins will reduce the area used for this purpose to one tenth of its previous allocation. Having not been emptied since 1990, existing settling ponds are emptied far too infrequently, and have far too adverse an effect, to rationalize their immense size.

Following relocation of these settling basins, removal of remaining boiler slag and coal ash in the existing basins, in addition to further remediation measures, will prepare them for wetland development. Byproducts harvested are also used for on-site construction, principally as aggregate and cementitious material for concrete.

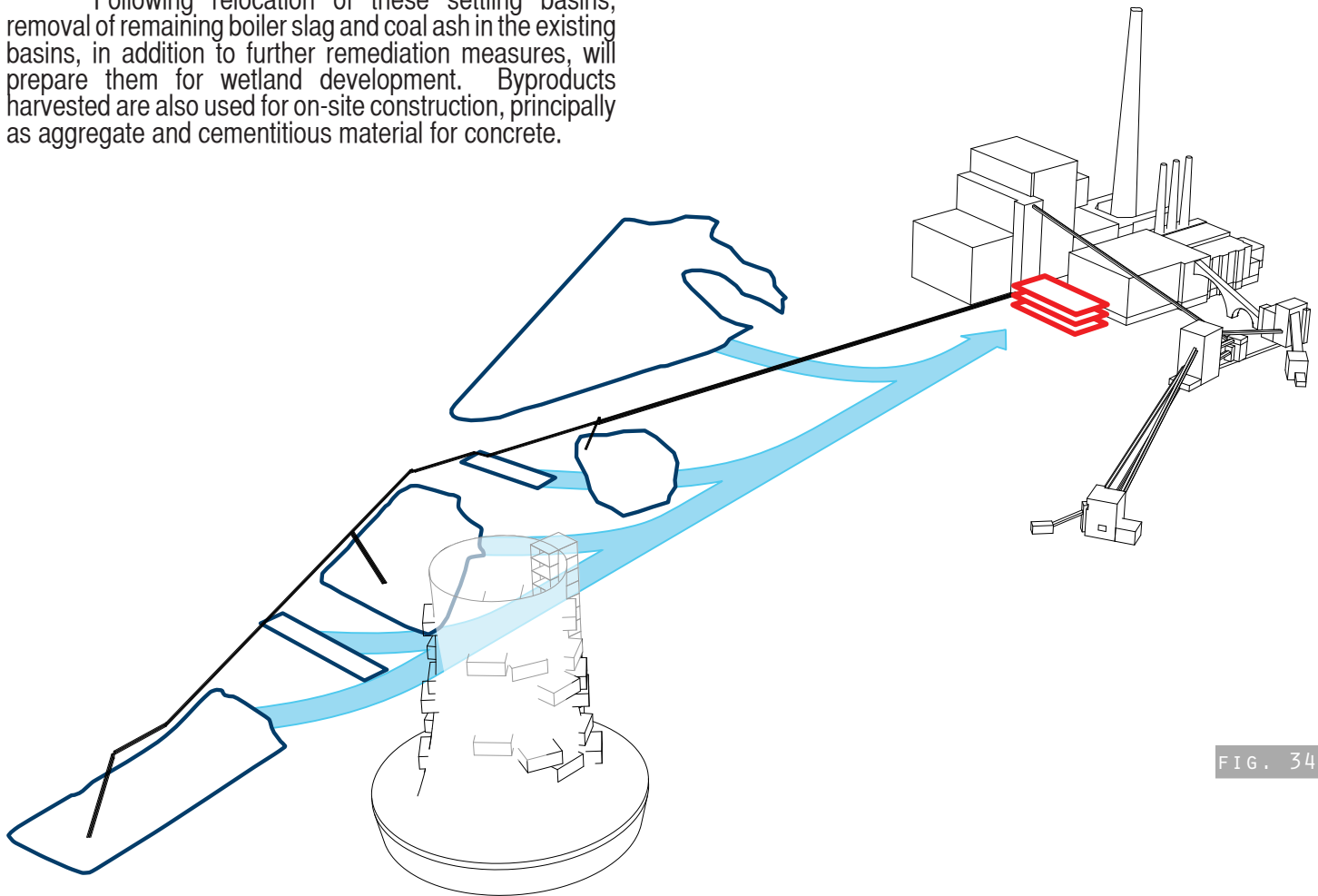


FIG. 34

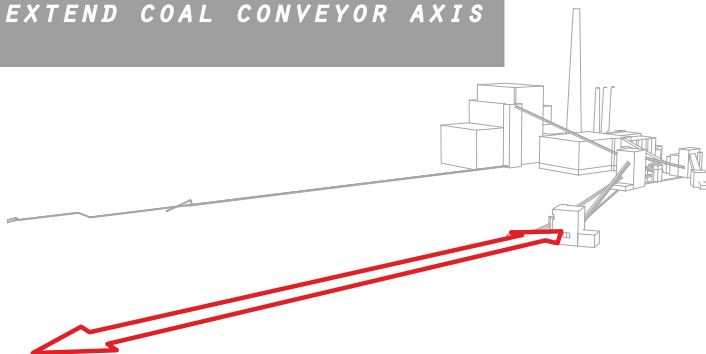
CONCEPTUAL DEVELOPMENT: *LOGIC AND FUNCTION*

Industrial infrastructure defines much of the site's developmental organization. Instead of adopting traditional grid or radial organizational systems, new buildings and infrastructure develop around existing site features.

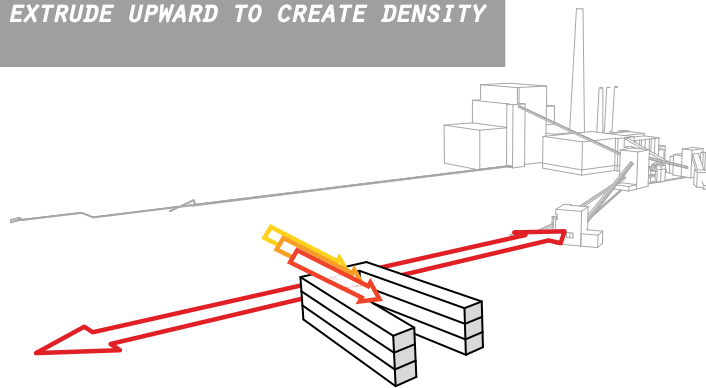
Development of the residential sector is largely dependant on the axis created by extension of an existing coal conveyor. This extension forms the core of an aerial circulation system allowing residents to access canopy walks or continue onward to preexisting elevated walks.

Built forms are developed to create a harmonious combination of abundant sunlight, semi-private and private space for residents, medium density living, and interior parking courts. Typical suburban models of seperated single family home construction are rejected in favor of medium density development to create pedestrian dominated space.

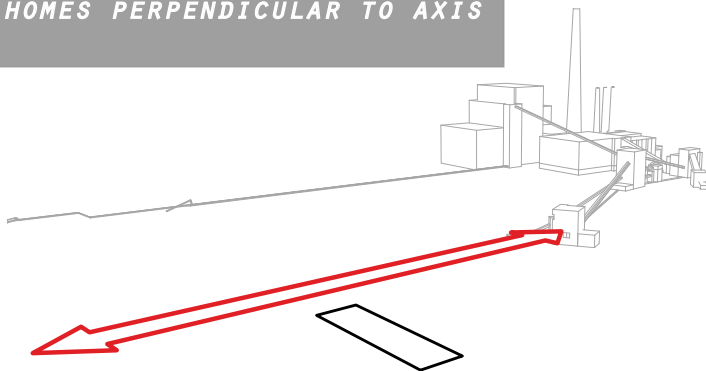
EXTEND COAL CONVEYOR AXIS



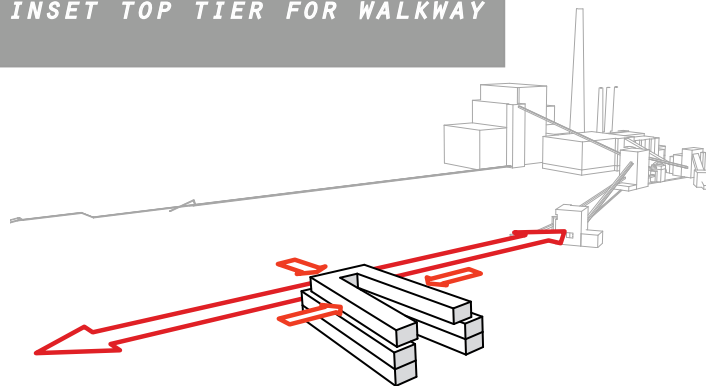
EXTRUDE UPWARD TO CREATE DENSITY



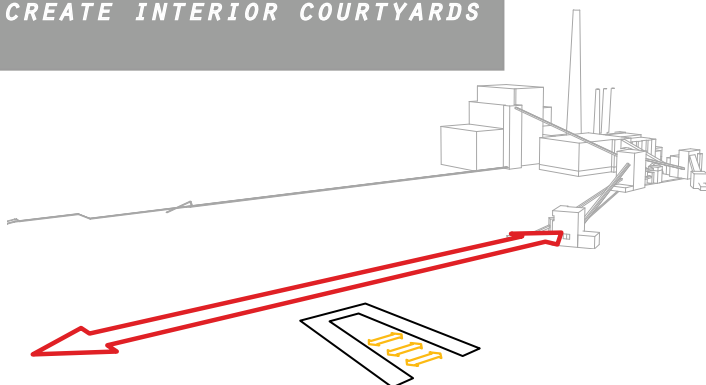
HOMES PERPENDICULAR TO AXIS



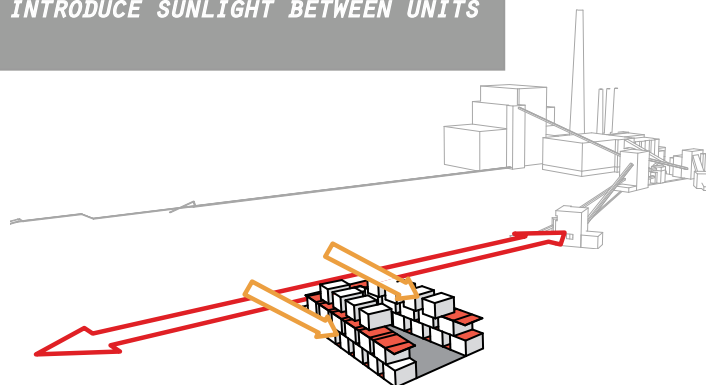
INSET TOP TIER FOR WALKWAY



CREATE INTERIOR COURTYARDS



INTRODUCE SUNLIGHT BETWEEN UNITS



RESIDENTIAL CONFIGURATION

EXTEND COAL CONVEYORS TO COOLING TOWER
TO ESTABLISH CENTRAL AVENUE AND AERIAL
CIRCULATION BASE

ESTABLISH A GREEN CORRIDOR TO CREATE
ACCESS FROM BEACH TO INTERIOR; CREATE
HIGHEST DENSITY ALONG CENTRAL AVENUE

DENSE RESIDENTIAL FRONTS ALONG CENTRAL
AVENUE; ESTABLISH PERPENDICULAR COURTYARDS
TO ALLOW PEDESTRIANS TO INFILTRATE SITE

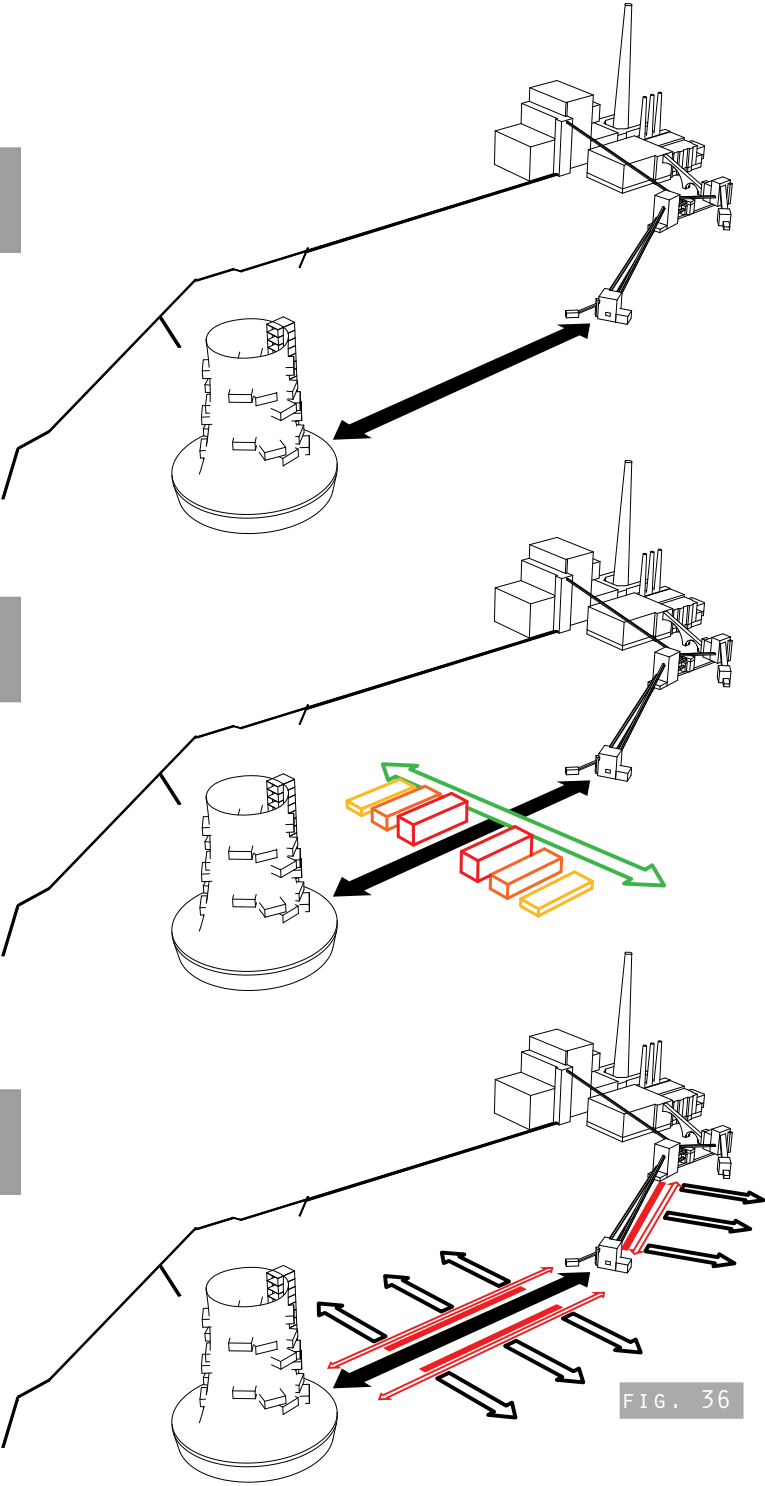


FIG. 36

PIPELINE REUSE AND CIRCULATION

ASH SLURRY PIPELINE EXTENDS ALONG SHORELINE, PROVIDES IDEAL FRAMEWORK FOR BEACH ACCESS

EXTEND OUTWARD TO CREATE CONTINUOUS CORRIDOR FROM SITE TO NATIONAL LAKESHORE; EXTEND NORTHWARD ALONG WETLAND MOUTH

PROVIDE VARIETY OF EXITS OFF OF WALKWAY TO EXPLORE BEACH AND WETLAND

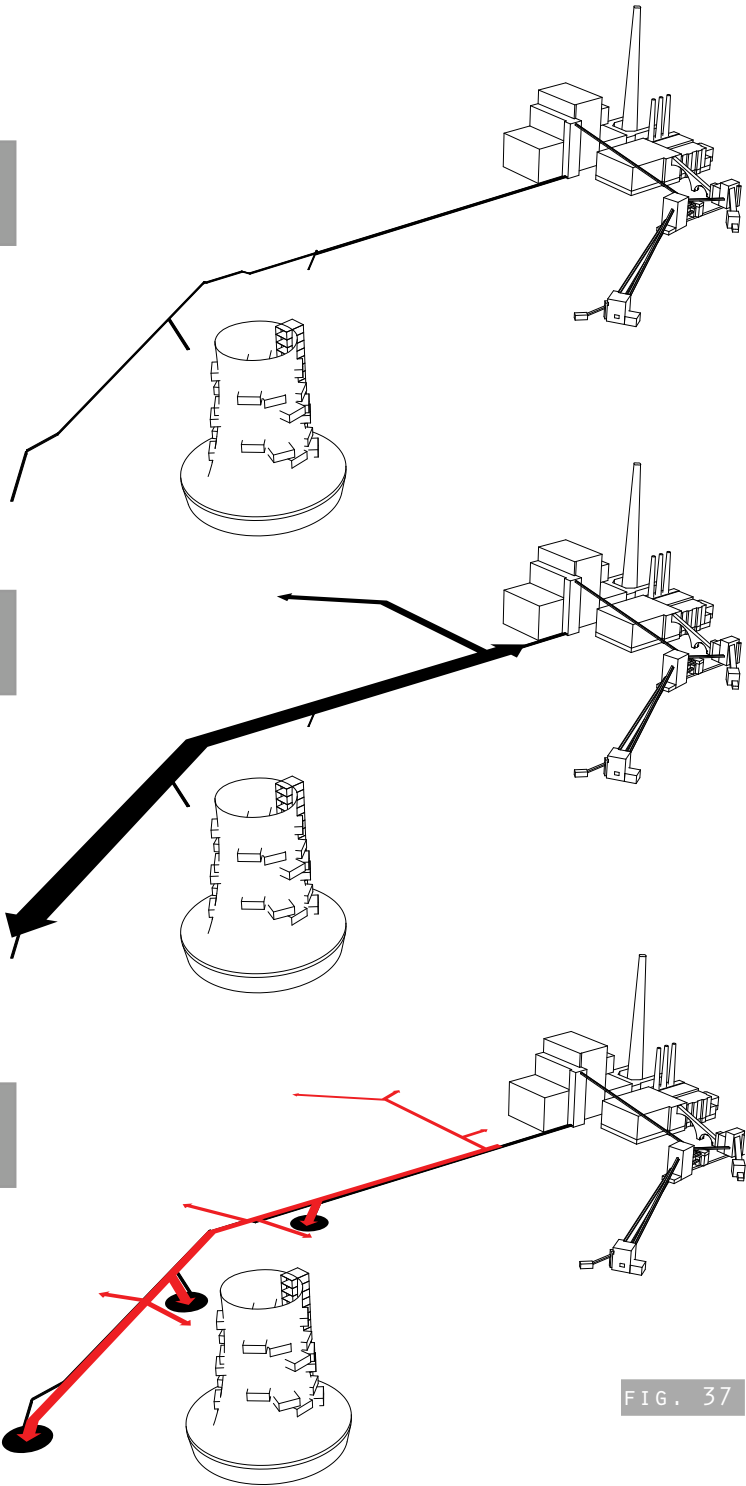


FIG. 37

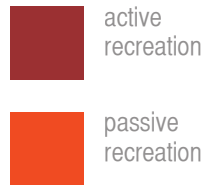
MASTER PLAN

INTEGRATION OF COMMUNITY AND ECOLOGICAL PRINCIPLES

Community and ecology coexist. All ecological areas are easily accessible to residents and visitors while forming a series of vibrant, functional dune forests and wetlands. Ecology and public space are synonymous, redefining the American concept of community.



- A. TRANSIT STATION
- B. EVENTS AND REC. LAWN
- C. COMMUNITY RECREATION CENTER
- D. ADVENTURE RECREATION CENTER
- E. SHOPS, EQUIPMENT RENTAL, & COMMERCIAL ACTIVITY
- F. CAFE AND PLAZA SPACE ON THE PROMENADE
- G. WOODLAND FISHING DOCKS
- H. SNACK STANDS ON THE PROMENADE
- I. PUBLIC BEACH AND WALKWAY
- J. EMBAYMENT AND WETLAND MOUTH
- K. WETLAND OBSERVATION TOWER
- L. PROTECTED EMBAYMENT WETLAND
- M. ROPES COURSE/CANOPY WALK
- N. MAIN COMMUNITY BEACH ACCESS
- O. PIPELINE WALKWAY
- P. COMMUNITY RETAIL AND COMMERCIAL
- Q. COOLING TOWER HOTEL & PUBLIC OBSERVATION PLATFORM
- R. COMMUNITY ACCESS



RECREATION

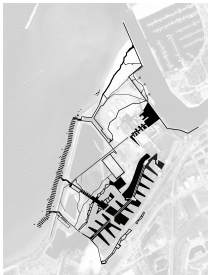
Both boiler houses are used to house centers of active recreation: the current boiler house is used for climbing and adventure recreation, while the former boiler house is host to community sporting courts and an indoor gymnasium.



LIVING

The public building at the center of residential development houses community necessities, such as a laundromat, daycare, and grocery store. Hotel guests are also within walking distance. All residential units are clustered to create residential density and proximity to ecological and commercial site elements.

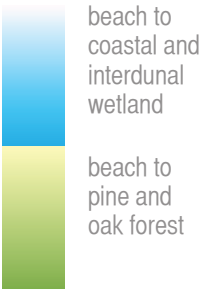
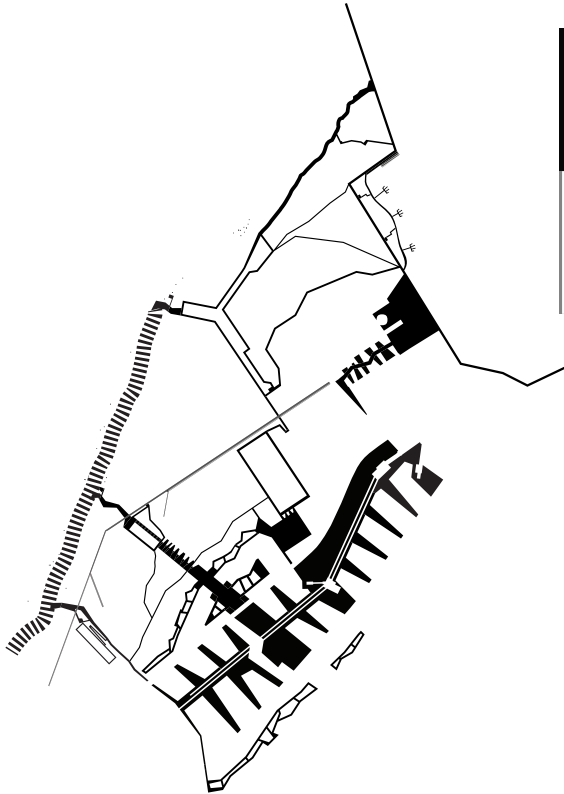
MASTER PLAN COMPONENTS



PUBLIC REALM

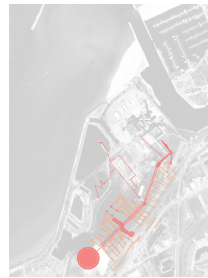


VEGETATION





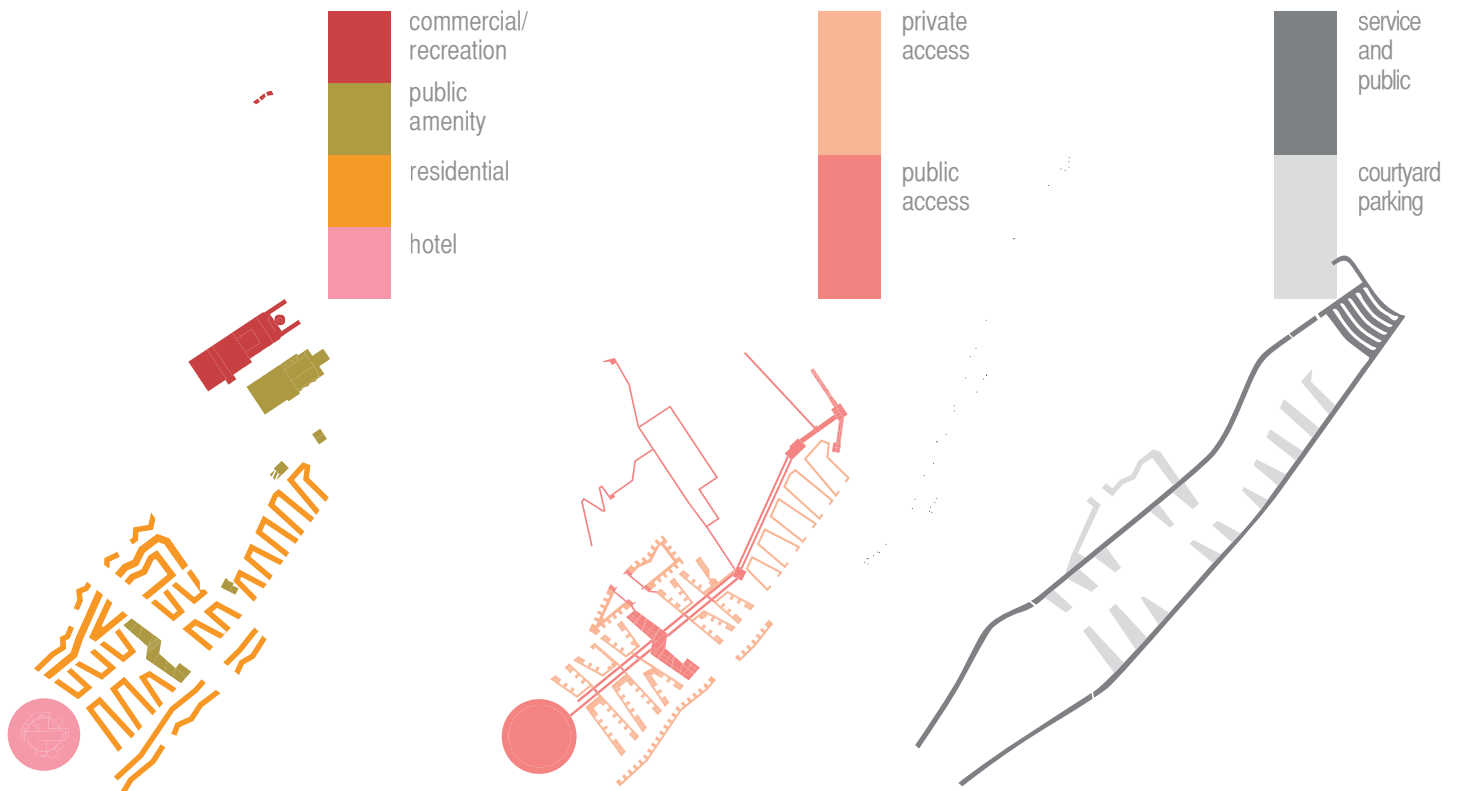
BUILDING
TYPOLOGIES



AERIAL
CIRCULATION



VEHICULAR
ACCESS



TEMPORAL EVOLUTION: *A FUNCTIONAL SHORELINE*

THERE IS POTENTIAL FOR ACCUMULATION OF SAND MEASURING UP TO 100" IN DEPTH ON THE WINDWARD SIDE OF NEWLY FORMING DUNES OVER TEN YEARS. THESE WINDWARD SLOPES FORM AT AN AVERAGE ANGLE OF 10 DEGREES, CREATING BEACHES AND FOREDUNES.

Beach development is one of the principal components of site development. Existing beach conditions have potential for sand accumulation, although the Michigan City jetty prevents any sand from being transported via littoral drift.

Once this littoral drift is reestablished through permeation of the jetty barrier, the potential for beach creation is reintroduced. To begin accumulating sand, littoral currents running parallel to the shoreline must be partially interrupted along the shoreline. Turbulence created by permeable barriers placed along the shoreline slows currents, dropping sand carried in the water.

To create this effect, the first layer of sheet piling is reoriented perpendicular to the shoreline. These pilings are only configured in sections of four and eight feet in length with up to ten feet between, allowing water to flow through while creating necessary turbulence.

After the series of sheet pile barriers accumulates enough sand to reach lake level, the sheet piling causes eolian deposition through the same principle. Wind carrying sand is slowed by the staggered sheet piles and sand is deposited around the base of these formations.

In effect, these sheet pile formations act as artificial embryo dunes through the creation of mounds. Pioneer species then colonize these mounds, leading to the creation of the first layer of foredunes.

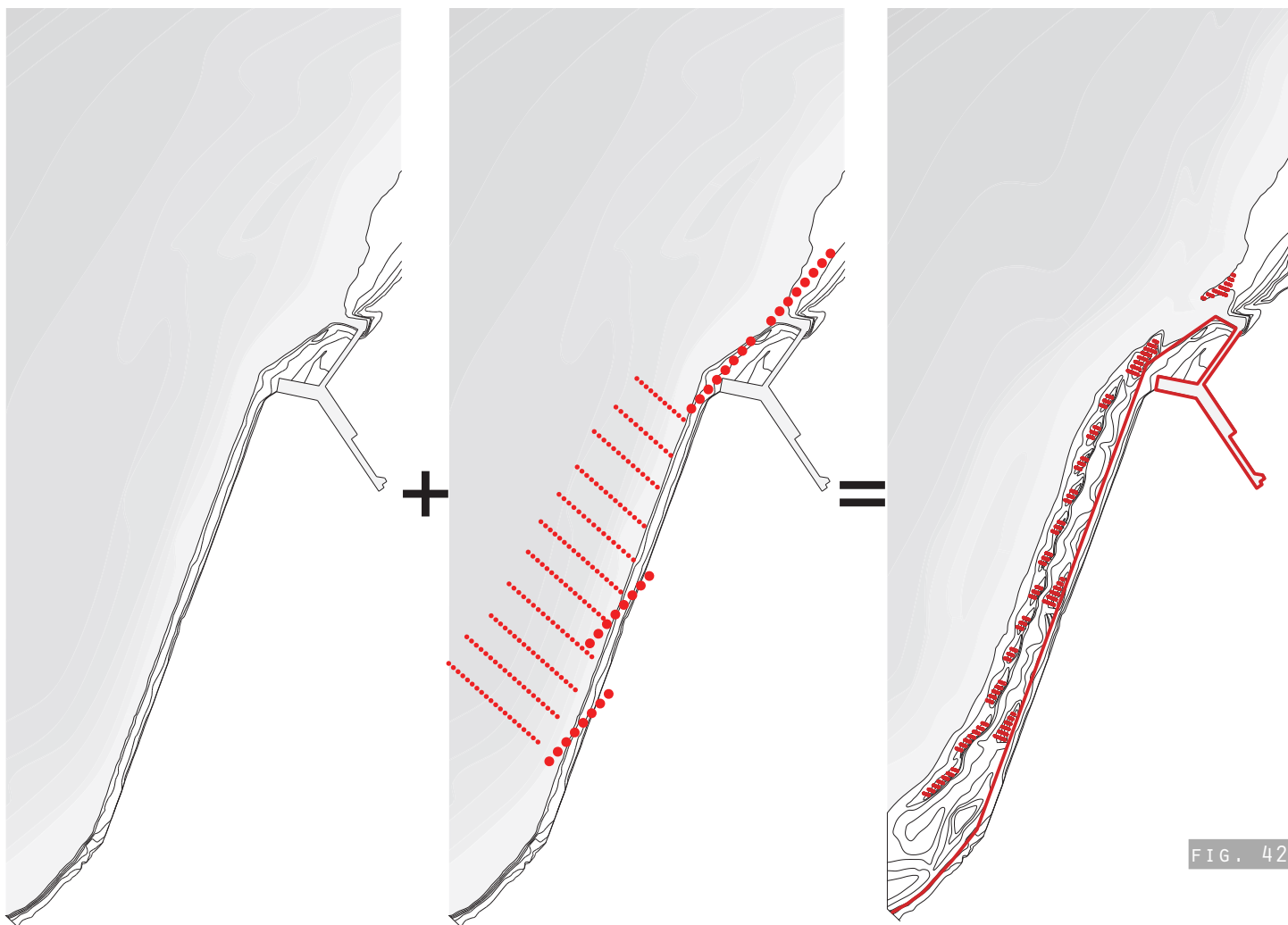


FIG. 42

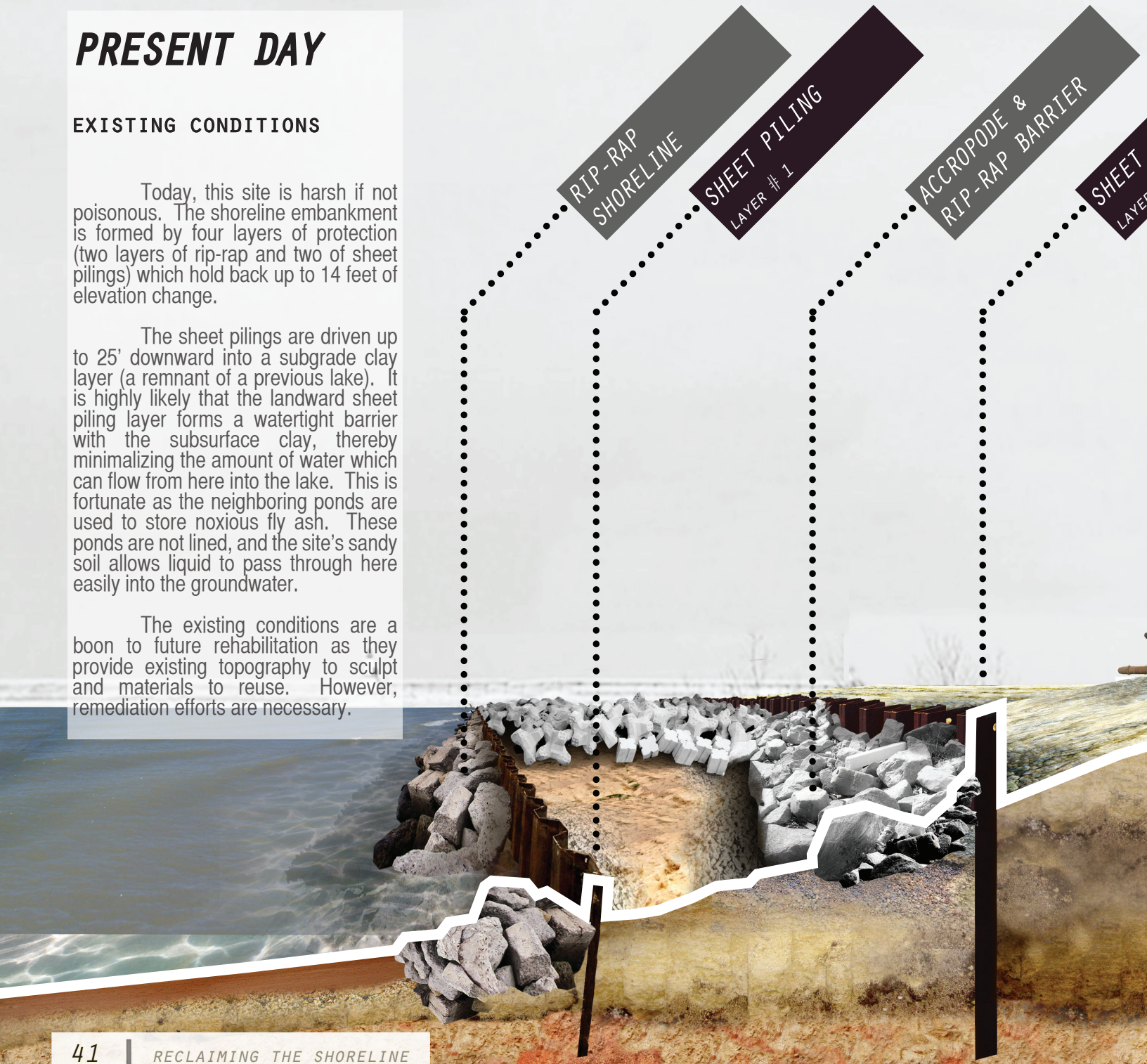
PRESENT DAY

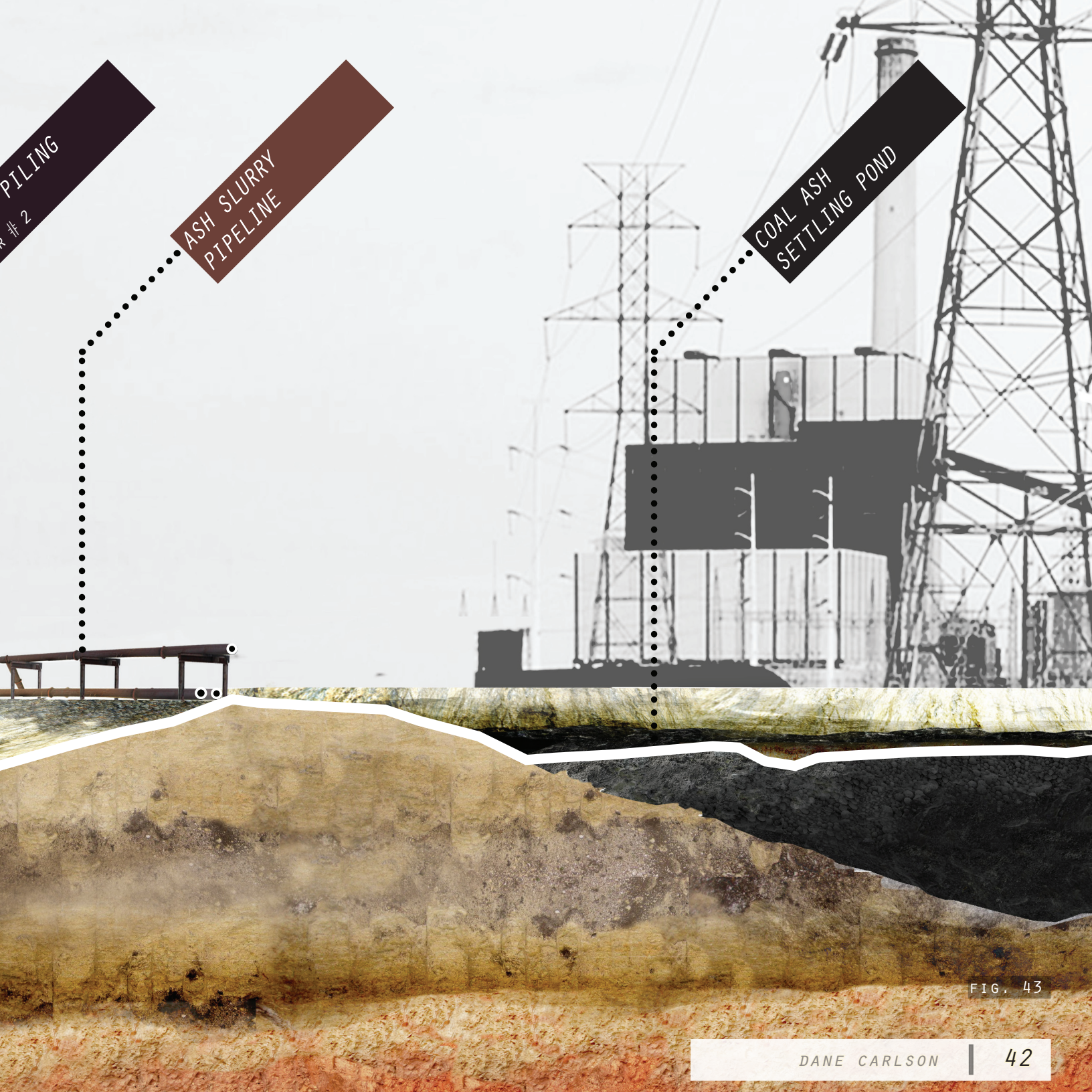
EXISTING CONDITIONS

Today, this site is harsh if not poisonous. The shoreline embankment is formed by four layers of protection (two layers of rip-rap and two of sheet piling) which hold back up to 14 feet of elevation change.

The sheet piling are driven up to 25' downward into a subgrade clay layer (a remnant of a previous lake). It is highly likely that the landward sheet piling layer forms a watertight barrier with the subsurface clay, thereby minimizing the amount of water which can flow from here into the lake. This is fortunate as the neighboring ponds are used to store noxious fly ash. These ponds are not lined, and the site's sandy soil allows liquid to pass through here easily into the groundwater.

The existing conditions are a boon to future rehabilitation as they provide existing topography to sculpt and materials to reuse. However, remediation efforts are necessary.





PILING

R # 2

ASH SLURRY
PIPELINE

COAL ASH
SETTLING POND

FIG. 43

+5 YEARS

PIONEER SPECIES

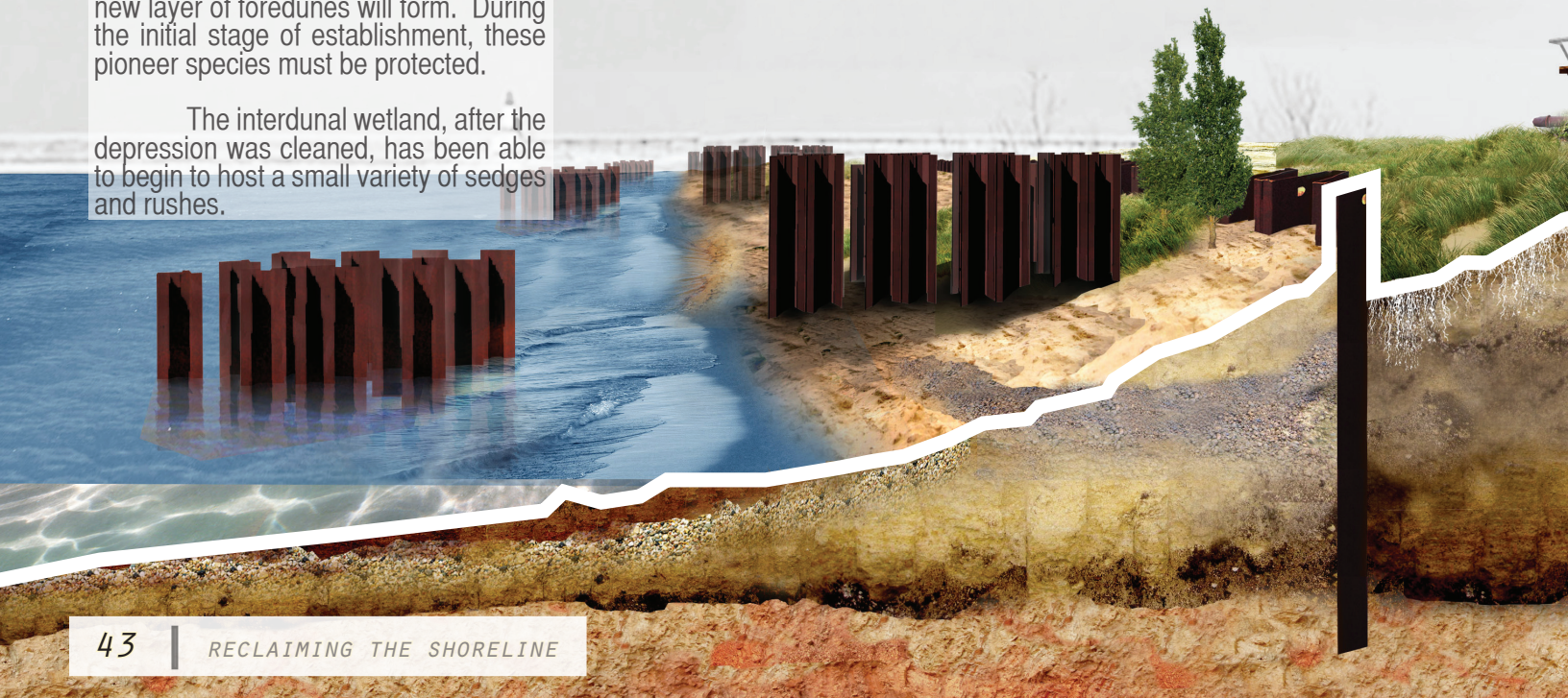
MARRAM GRASS *AMMOPHILIA BREVIGULATA*
COTTONWOOD *POPULUS DELTOIDES*

INITIAL INTERVENTIONS

Five years from today, initial steps have been taken to begin accelerated sediment accumulation for the formation of dunes. The first layer of sheet piling has been removed and driven in staggered formations into the existing beach and shallow lakebed. Perpendicular to the littoral flow of sediment, these barriers interrupt wind and water flows carrying sand and force them to drop the sediment to form dunes.

The ash slurry pipeline has been turned into a vital educational access corridor, allowing the public to witness the site's transformation. The beach, however, is not yet accessible. As pioneer species colonize the sand to stabilize it, new sand accumulates and a new layer of foredunes will form. During the initial stage of establishment, these pioneer species must be protected.

The interdunal wetland, after the depression was cleaned, has been able to begin to host a small variety of sedges and rushes.



INTERDUNAL WETLAND

HORNED BLADDERWORT *UTRICULARIA CORNUTA*
WILLOW *SALIX SP.*
BALTIC RUSH *JUNCUS BALTICUS*
SHORT-TAILED RUSH *JUNCUS BREVICAUDATUS*
STONEWORT *CHARA CONTRARIA*
GREAT BLUE LOBELIA *LOBELIA SIPHILITICA*

PINE DUNE

JACK PINE *PINUS BANKSIANA*
WHITE PINE *PINUS STROBUS*

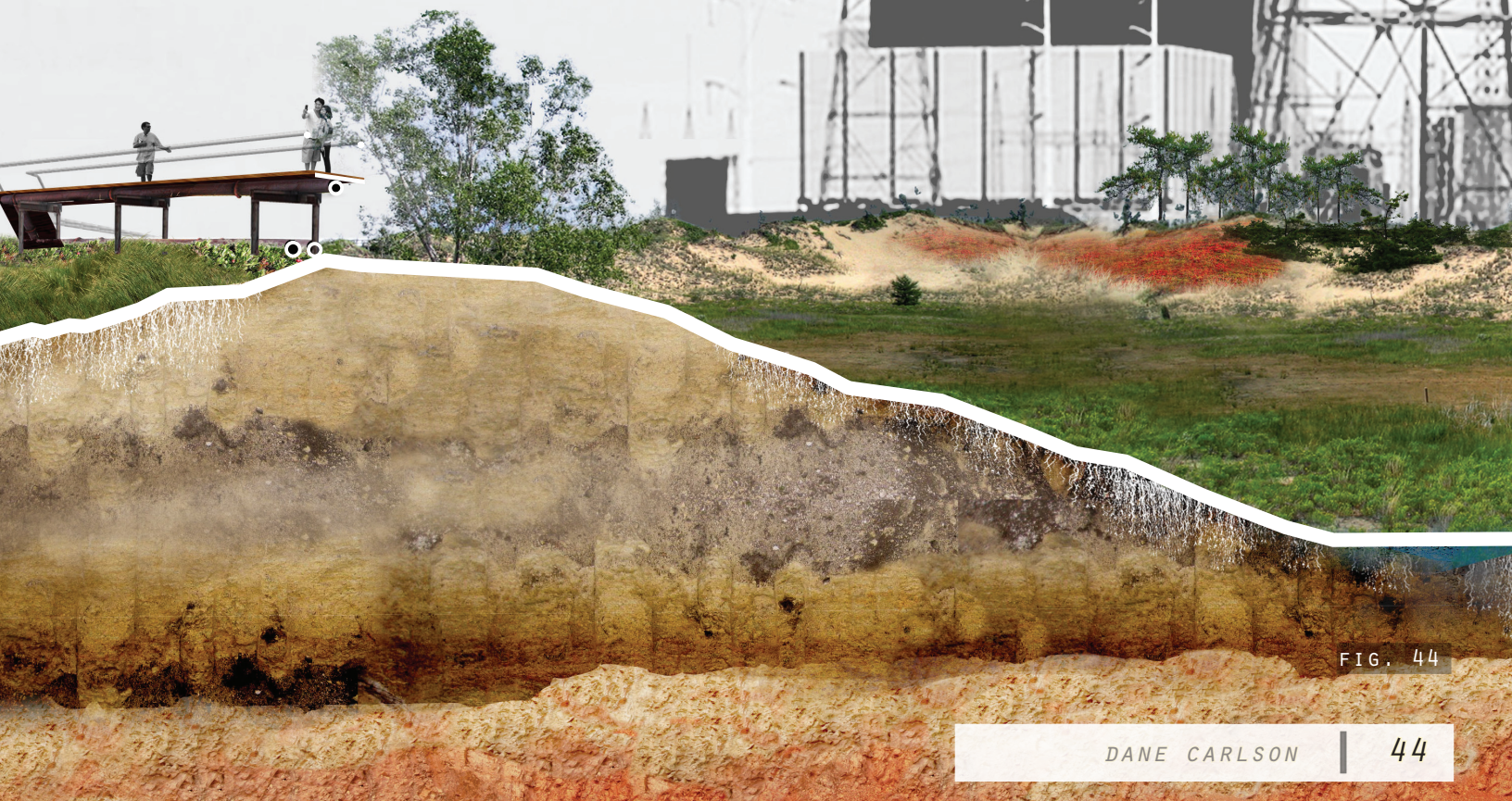


FIG. 44

+10 YEARS

REGENERATION & GROWTH

25 years from today, temporal process (in addition to accelerated development through planting and other efforts) has established the beginnings of a vibrant and functional successional ecology. New foredunes have accumulated, protecting the once vulnerable layer of dunes behind it from harsh wind and waves. This not only protects new plant species, but also allows for mobile access infrastructure for pedestrians.

The ash slurry pipeline has been turned into a vital educational access corridor, allowing the public to watch the site transform. The beach, however, is not yet accessible. As pioneer species colonize the sand to stabilize it, new sand accumulates and a new layer of foredunes will form. During the initial stage of establishment, these pioneer species must be protected.

The interdunal wetland has continued to host a more and more diverse plant palette. Farther from the beach, the jackpine forest has become more established and will continue to evolve, eventually becoming an oak-hickory forest.

PIONEER SPECIES

MARRAM GRASS *AMMOPHILIA BREVIGULATA*
COTTONWOOD *POPULUS DELTOIDES*



PIONEER/STABLE FOREDUNE SPECIES

MARRAM GRASS *AMMOPHILIA BREVIGULATA*
COTTONWOOD *POPULUS DELTOIDES*
BEARBERRY *ARCTOSTAPHYLOS UVA-URSI*
COMMON MILKWEED *ASCLEPIAS SYRIACA*
LITTLE BLUESTEM *ANDROPOGON SCOPARIUS*
SAND CHERRY *PRUNUS PUMILA*
ROUGH BLAZING STAR *LIATRIS ASPERA*
AZURE ASTER *ASTER AZUREUS*

PINE DUNE

JACK PINE *AMMOPHILIA BREVIGULATA*
WHITE PINE *POPULUS DELTOIDES*
JUNIPER *JUNIPERUS COMMUNIS*
BLACK OAK *QUERCUS VELUTINA*
WITCHHAZEL *HAMAMELIS VIRGINIANA*
SOLOMON'S SEAL *POLYGONATUM BIFLORUM*
COLUMBINE *AQUILEGIA CANADENSIS*

INTERDUNAL WETLAND

NEEDLE SPIKERUSH *ELEOCHARIS ACICULARIS*
WILLOW *SALIX SP.*
BALTIC RUSH *JUNCUS BALTICUS*
SHORT-TAILED RUSH *JUNCUS BREVICAUDATUS*
STONEWORT *CHARTA CONTRARIA*
KALM'S ST. JOHN SWORT *HYPERICUM KALMIANUM*
FLOATING LEAF PONDWEED *POTAMOGETON NATANS*
LESSER DUCKWEED *LEMNA MINOR*
HORNED BLADDERWORT *UTRICULARIA CORNUTA*
GREAT BLUE LOBELIA *LOBELIA SIPHILITICA*

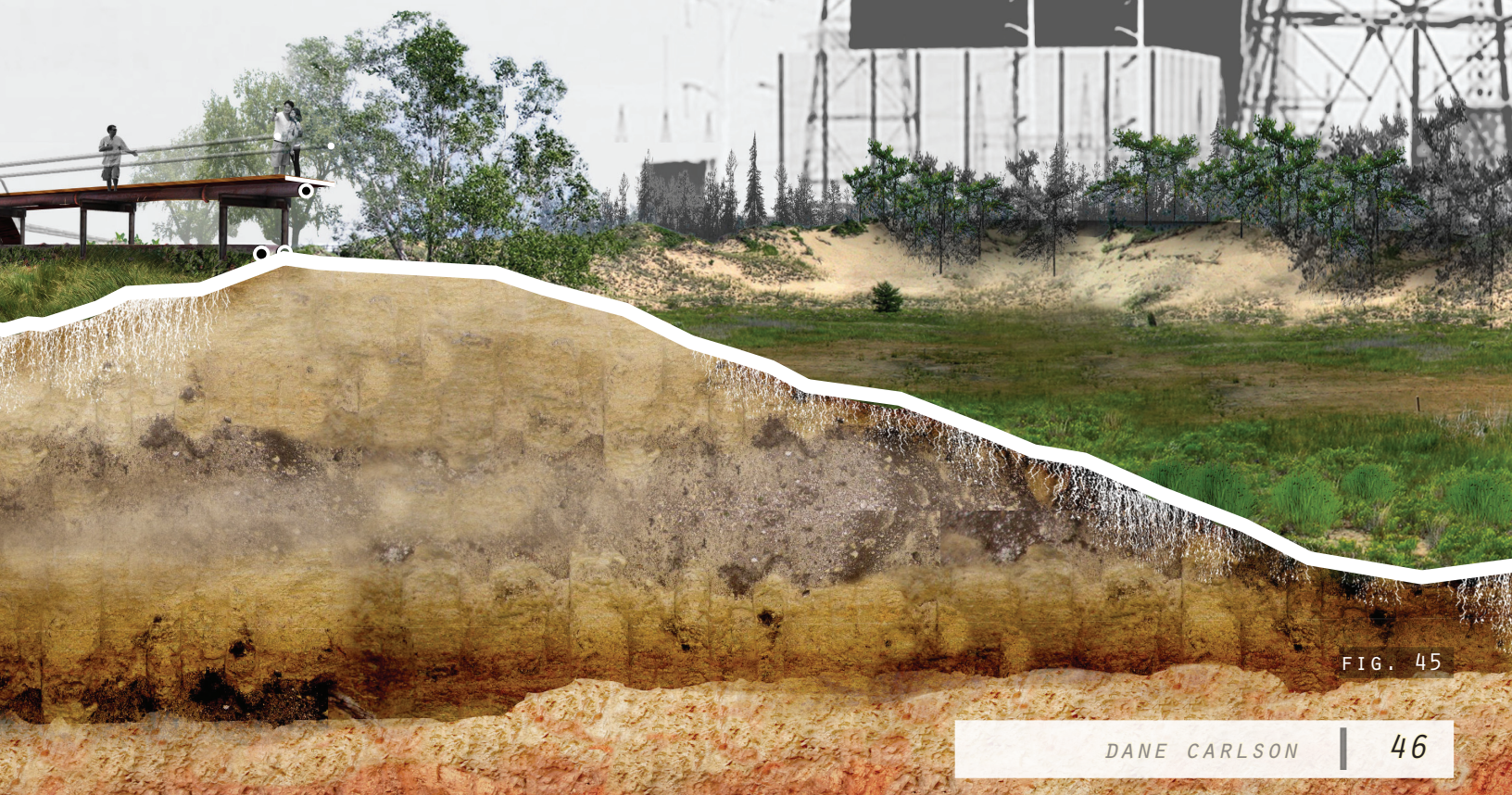


FIG. 45



FIG. 46



FIG. 47



BEFORE: *BOILER SLAG POND*

In addition to a series of coal ash settling ponds, one settling area holds boiler slag, another coal combustion by-product. While not as harmful as coal ash, it still poses a barrier to ecological function and growth. The pipeline, seen in the middle of the photo, pumps the slag slurry to the pond.

To the left, one of the series of coal ash settling ponds has edges constructed of sheet piling and lies directly adjacent to a significant grade change which forms the eastern edge of the third ash settling pond.



AFTER: *CONSTRUCTED WETLAND & FOREST*

This portion of the site is transformed into a vital circulation junction. Pathways extend outward from the lowest density portions of residential development and lead directly toward the constructed wetland created in the former settling pond. The pipeline walkway connects to the groundplane via a ramp while the groundplane walkway leads directly to the expanded beach.

Plant communities abound; pioneer species colonize sand dunes near the shore, while pine forest species develop on more stable soils further inland as organic content increases. An oak savannah occupies the former slag pond depression and, due to organic soil amendments, is able to capture surface water before it infiltrates into the sand below.



FIG. 48



FIG. 49



BEFORE: *REVETMENT SHORELINE*

Due to the necessity of maintaining the structural integrity of each coal ash settling pond, the shoreline of the generating station is a heavily fortified revetment. While naturally occurring beaches create a gradual topographic transition, this condition maintains up to 16 feet of grade change within a short distance.

The ground on which the pipeline rests is relatively flat and, directly southeast of this location, the NIPSCO property transitions into the Indiana Dunes National Lakeshore.

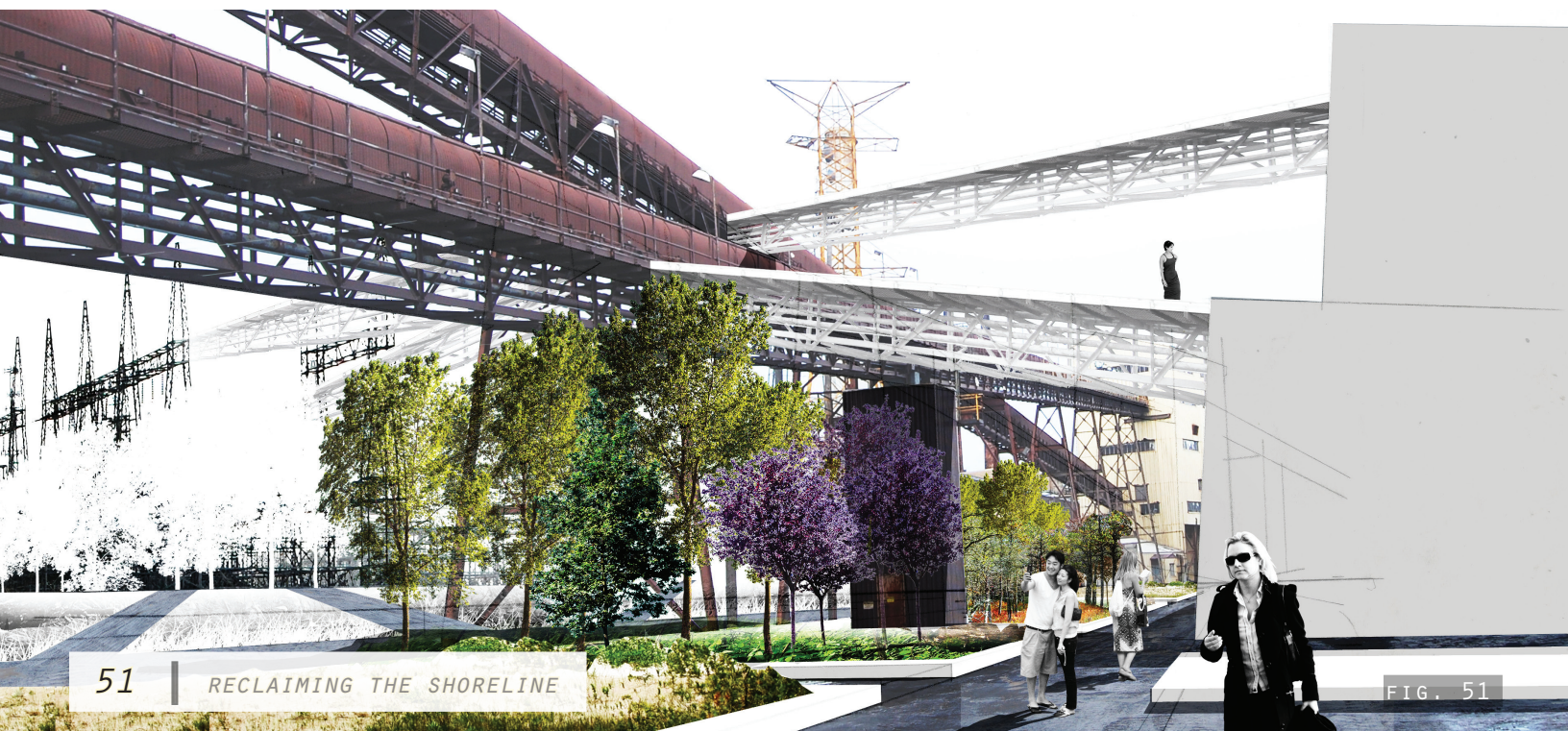


AFTER: *BEACH & FOREST STRATA*

Removal of the shoreline revetment creates opportunities for colonization of pioneer species as well as eventual evolution of scrub and pine vegetation which stabilize the dune face. The shoreline is transformed into an independently ecologically functional zone which is accessible by pedestrians through various routes. The pipeline is transformed into a walkway to provide aerial access and links a series of depressed platforms which provide opportunities for wetland education.



FIG. 50



51 | RECLAIMING THE SHORELINE

FIG. 51



BEFORE: *COAL CONVEYOR SYSTEM*

This system of conveyors transports coal from the massive 150,000 ton pile to the boiler house. The conveyors pass through a series of towers and eventually climb over 200' to reach their destination at the top of the boiler house.

All surrounding structures are of temporary construction and have not been deemed to be an important component of adaptive reuse strategy on site.



AFTER: *GREEN AVENUE AND AERIAL ACCESS*

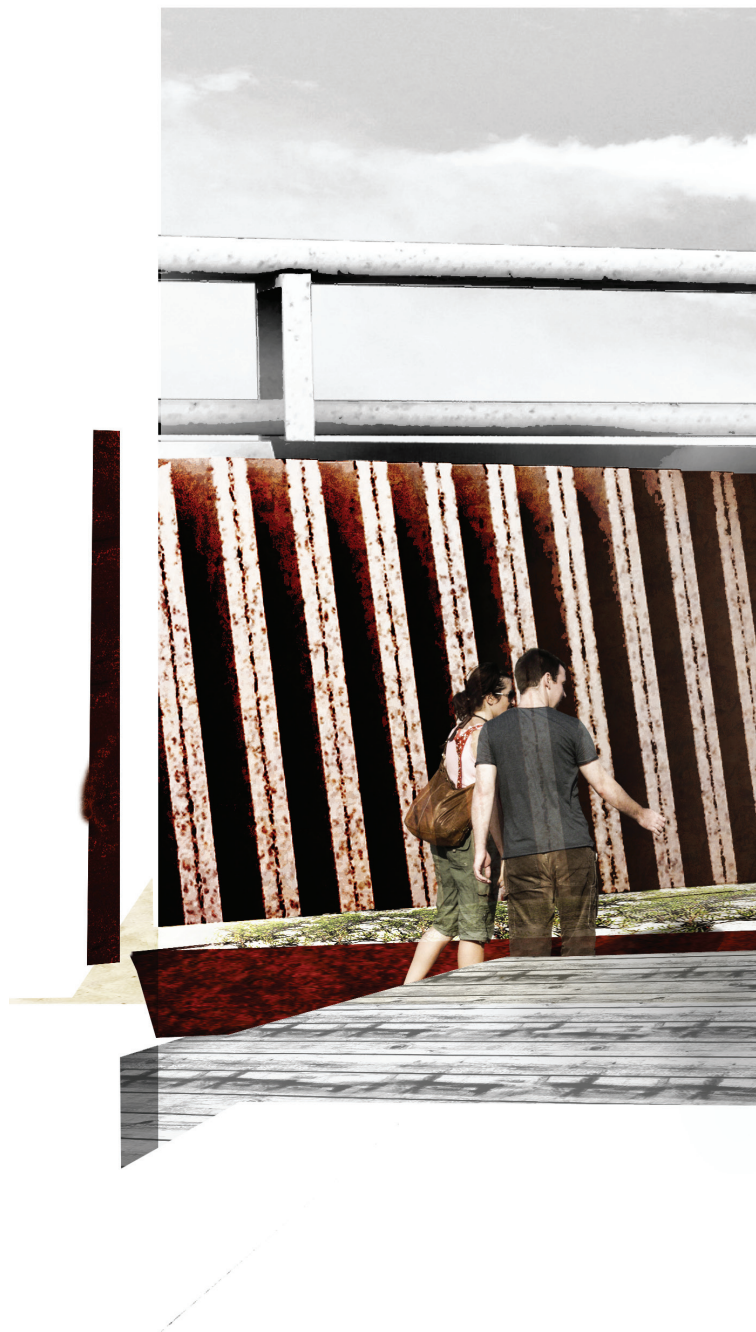
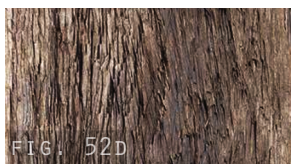
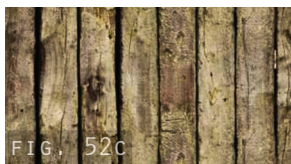
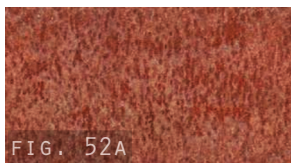
Forming the central axis for residential development, this green avenue is defined by alternating pockets of dune and woodland vegetation. The most dense portions of residential development front this area and also have direct access to the aerial circulation system based on the existing conveyors. This system reaches outward and allows the adventurous visitor to explore forest canopy in the former transformer towers to the north.

Small, semi-private courtyards lie perpendicular to the green avenue. Both courtyards and the green alley provide space for relaxation, play, and other activities.

BEACH ACCESS

Three pathways delve into existing topography to open access to new beaches. Sheet pilings form the walls of these new gulleys, ensuring that the industrial metal sheet pilings maintain a constant material presence. Sign posts are made of large timbers and show site maps and educational materials intended to orient visitors with the site.

Instead of introducing an impermeable hardscape, the groundplane is “paved” with sand and stabilized by open planks held together by ropes. Dune grasses and jackpines grow atop the sheet pile walls, and low groundcovers suitable for sandy soils grow in an elevated planter in the center of the pathway.







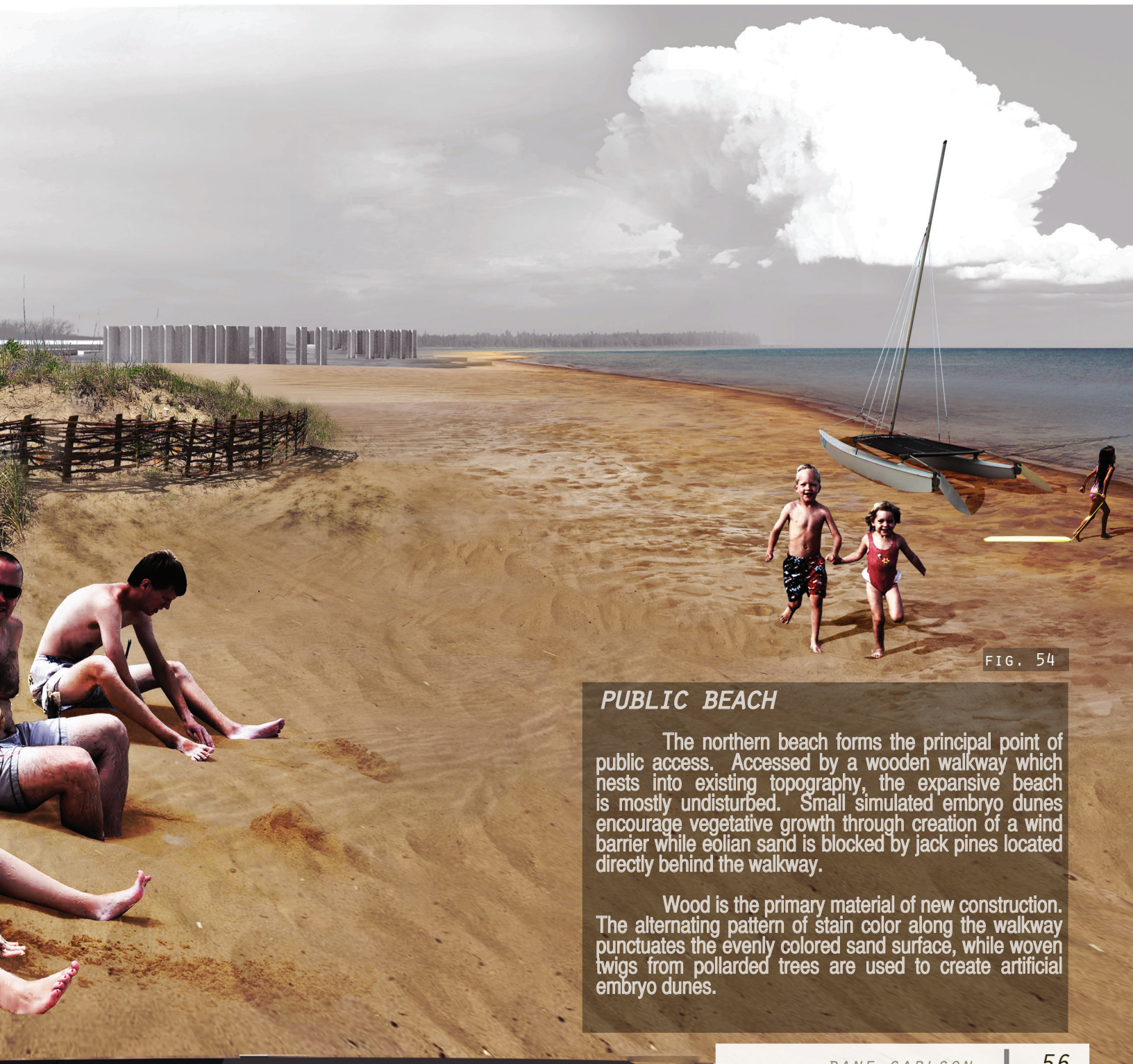
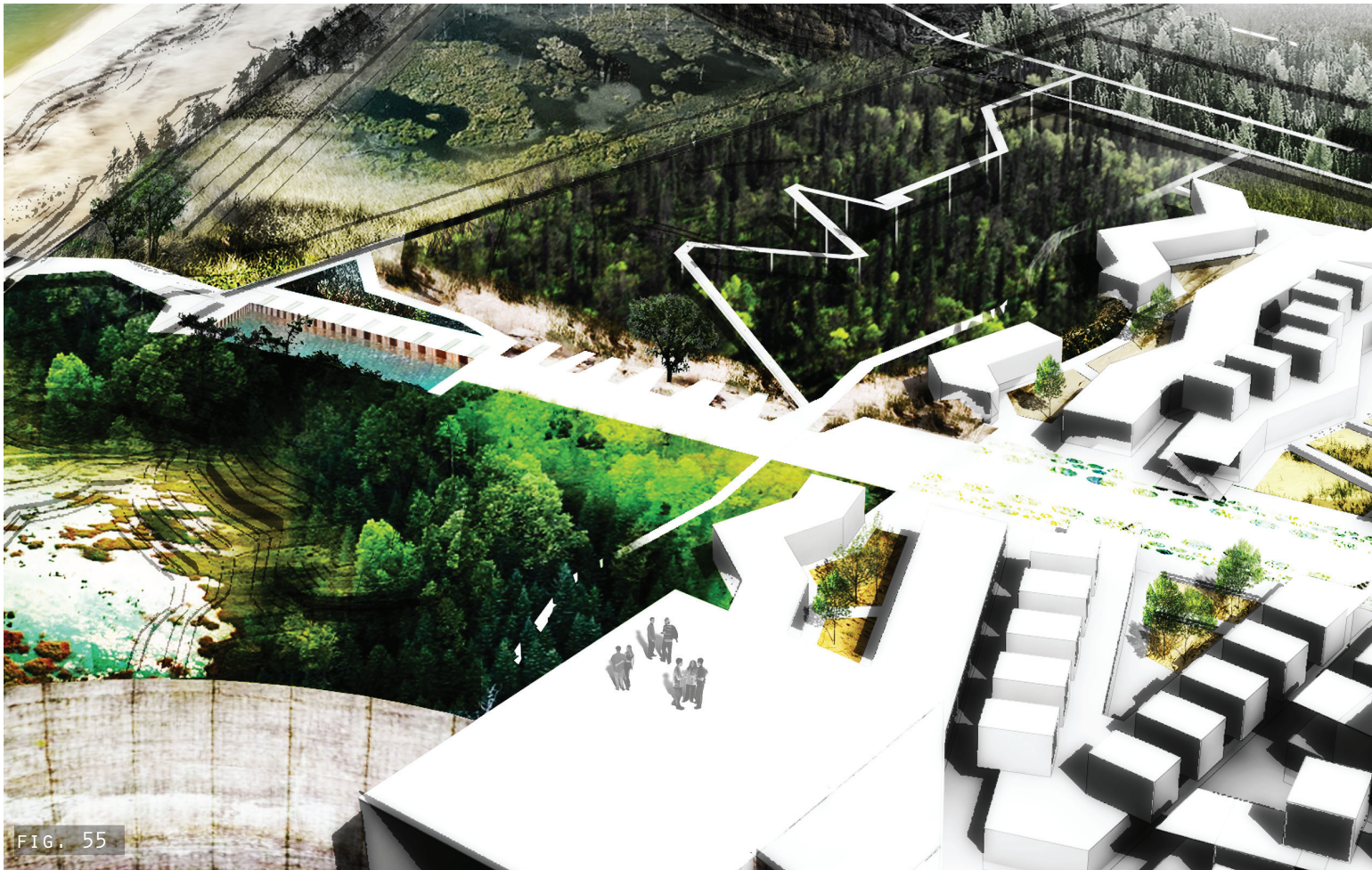


FIG. 54

PUBLIC BEACH

The northern beach forms the principal point of public access. Accessed by a wooden walkway which nests into existing topography, the expansive beach is mostly undisturbed. Small simulated embryo dunes encourage vegetative growth through creation of a wind barrier while eolian sand is blocked by jack pines located directly behind the walkway.

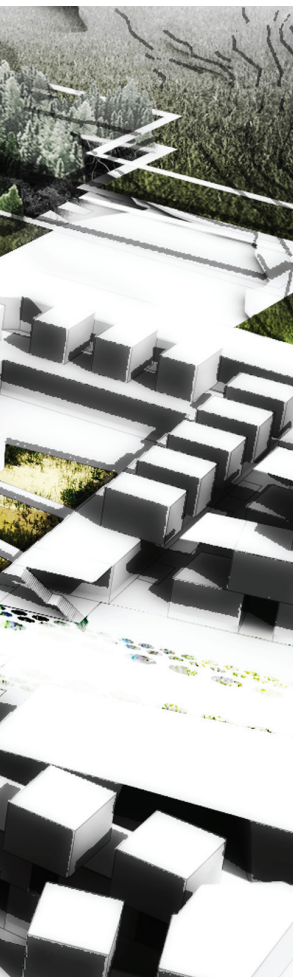
Wood is the primary material of new construction. The alternating pattern of stain color along the walkway punctuates the evenly colored sand surface, while woven twigs from pollarded trees are used to create artificial embryo dunes.



COMMUNITY & ECOLOGY

As residential density lowers on the fringes of the neighborhood, plants and sand become entwined with walkways and homes. Planted courtyards are occupied by pioneer species to provide an aesthetic separation from surrounding wooded zones, create playspace for children in the sand, and maintain the stormwater infiltration capacity of the Tolleston beach sand.

The viewing platform at the top of the cooling tower hotel provides a viewing point for the entire site available to both hotel guests and the public. From the residential clusters below, walkways extend upward into the canopy and outward to the beach.



WOODLAND MATERIAL REUSE

As sheet piling reuse is a critical component of beachfront revitalization, rip-rap and accropode reuse is a keystone of woodland development. To allow pathways in oak-hickory and jackpine forest zones to be elevated above grade, these concrete elements are utilized as structural supports for walkways.

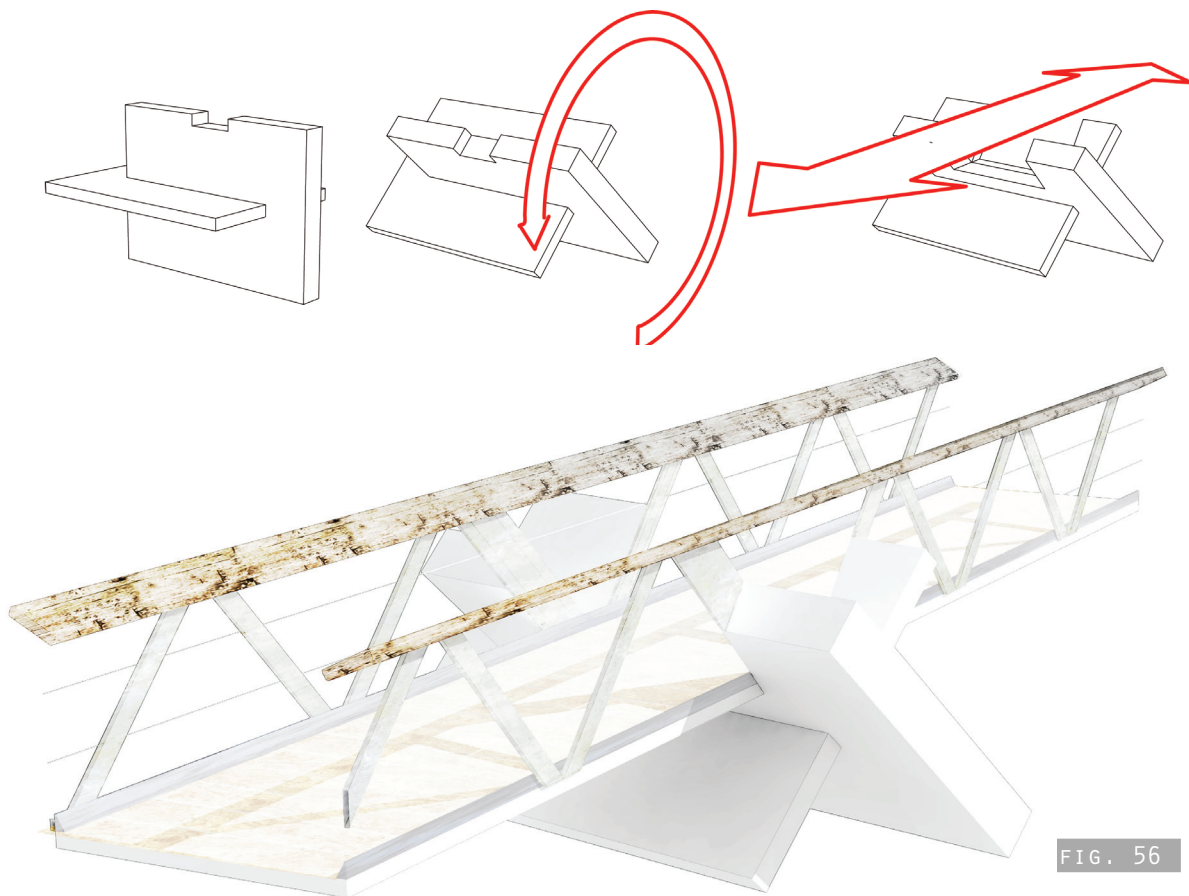


FIG. 56



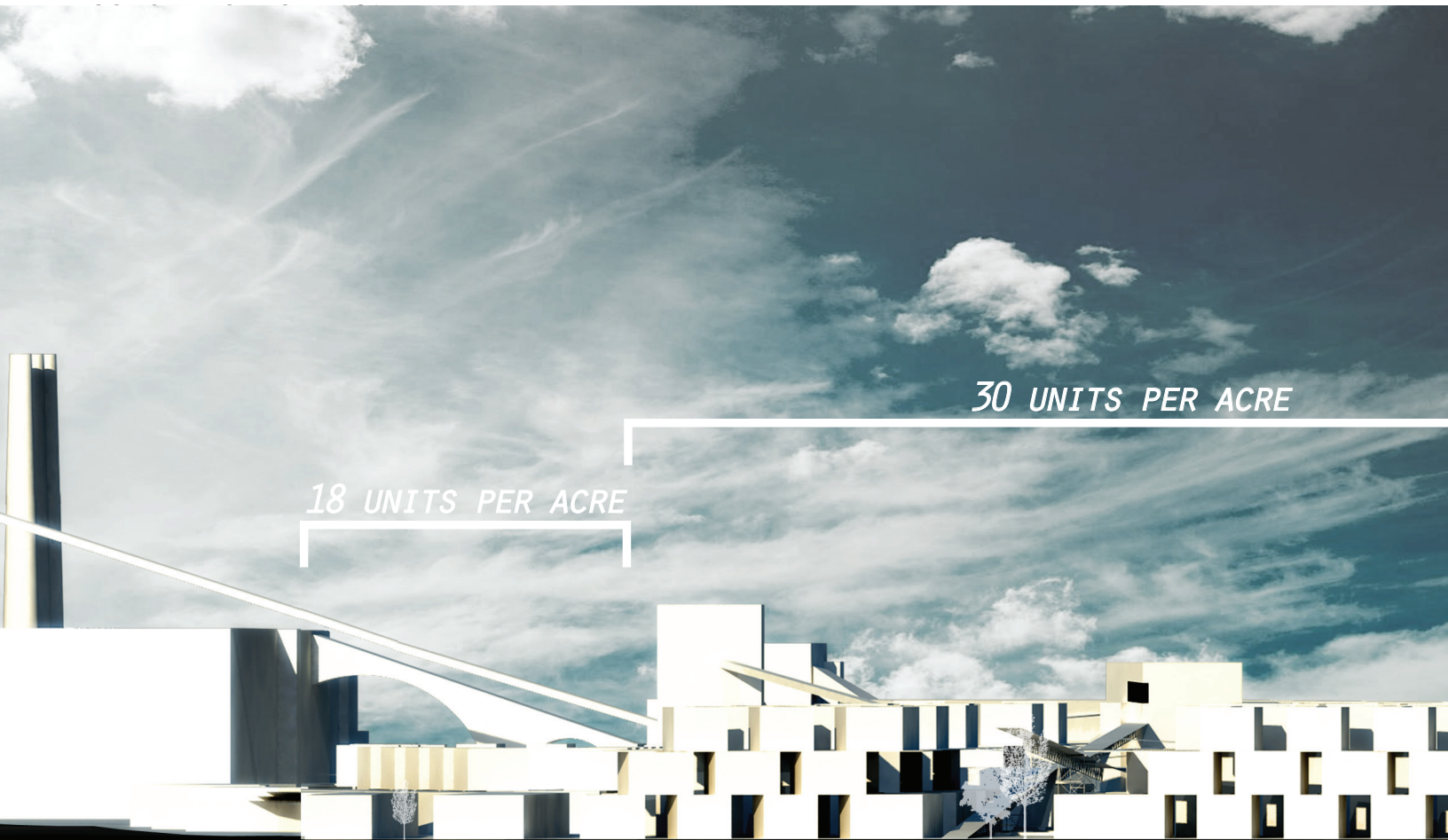
RESIDENTIAL COURTYARDS

Between each residential building lies a distinct courtyard serving as a recreational or contemplative space. Residences front on these courtyards, allowing sunlight to infiltrate into homes while providing views of playing children and vibrant public landscapes throughout the year. Perpendicular to the green avenue, the courtyards allow all pedestrians to access and walk through while isolating them from the principal pedestrian walk.

Materials and design shift from one courtyard to the next: shown is a play space for neighborhood children. A series of undulating concrete mounds creates unstructured playspace for king of the hill or snowball fights, while the sand box provides the opportunity to build sand castles and dig holes. Stormwater infiltration also occurs through the sand box, filtering downward to the sandy soil below.

FIG. 58





18 UNITS PER ACRE

30 UNITS PER ACRE

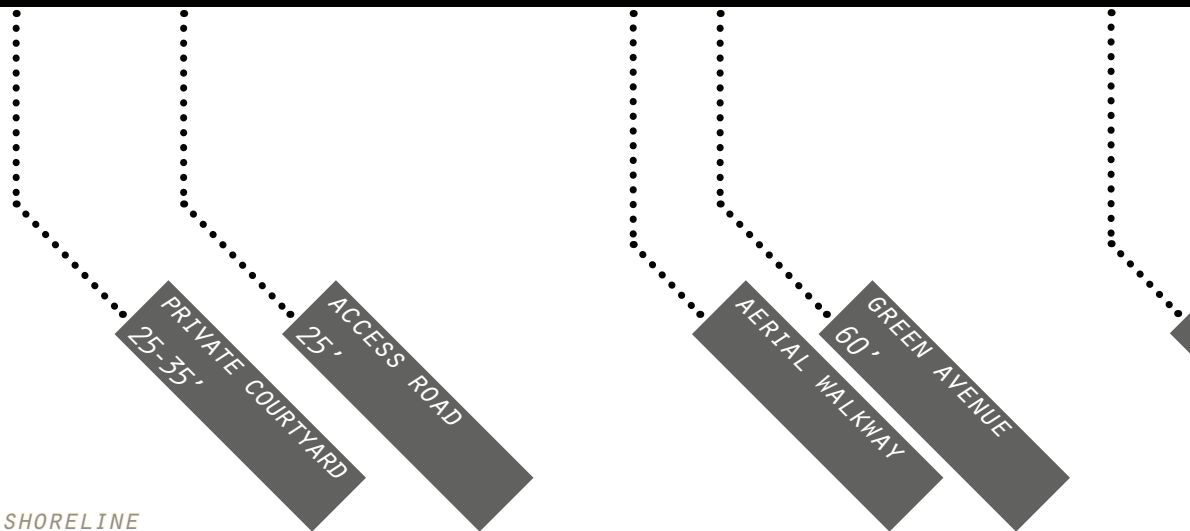


FIG. 59

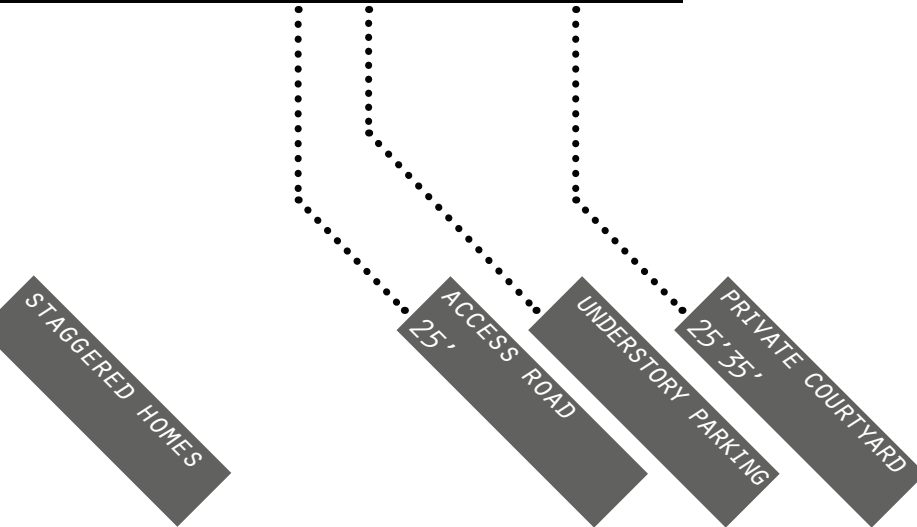


RESIDENTIAL SECTION

At the center of the community lies the green avenue and above it a series of aerial walkways providing access to rooftop courtyards and beyond. The most dense portion of this residential area lies directly adjacent to this central features with a density of 30 units per acre. Units are staggered 15' apart from each other to provide small exterior storage space, maximize sunlight, and provide a non-public entry to each home.

Access from exterior courtyards to interior parking courts is simple and can be gained through 15' gaps between units on the ground plane. Behind the first layer of dense buildings lies a pair of access roads which provide access to parking for all units. Although a necessity, these roads are not integral to site organization and fit within the larger pedestrian network rather than determining its configuration.

Beyond the access roads lies another set of units, these being less dense and rising lower than the central buildings. Each set of rowhomes lies parallel to a linear private courtyard for residents which is populated by sand and dune vegetation to create both a playspace for neighborhood children and stormwater infiltration points.



ACCESS & CIRCULATION

Fluid circulation is a principal pillar of architectural development. Building footprints are formed around courtyard spaces and pedestrian access systems rather than defining them.

While parking is a necessary element of Midwestern life, here it is the secondary circulation system. Running parallel to the central green avenue, access roads do not cross this central pedestrian artery. One parking space is provided for each unit throughout the neighborhood as the majority of necessities for daily life can be purchased on site within walking distance.

Courtyard access is another central pillar of life on site. All units front on vibrant greenspace defined by vegetative communities which vary based on location. Some courtyards encourage play and activity while some maintain serene space for sitting, reading, or reflection.

The aerial circulation system is born at the center of the neighborhood from an extension of the existing coal conveyor system. It stretches outward to the cooling tower hotel, into the pine forest canopy, and toward recreational facilities to the east. Because of this, all residents can access site amenities through aerial access routes if desired.

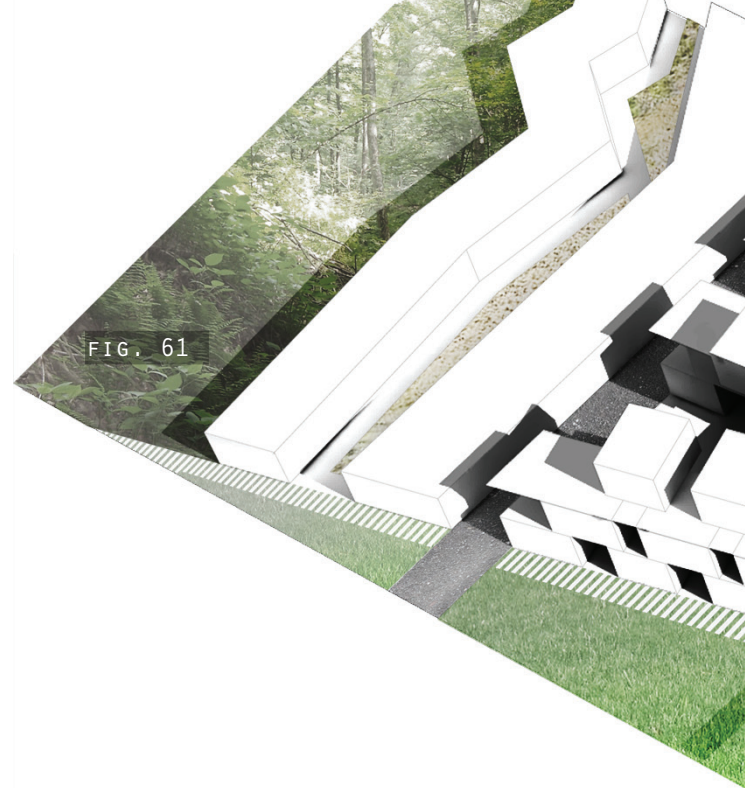
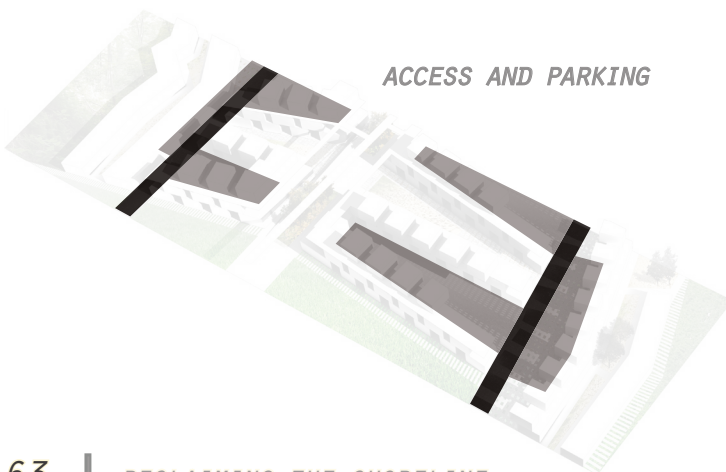
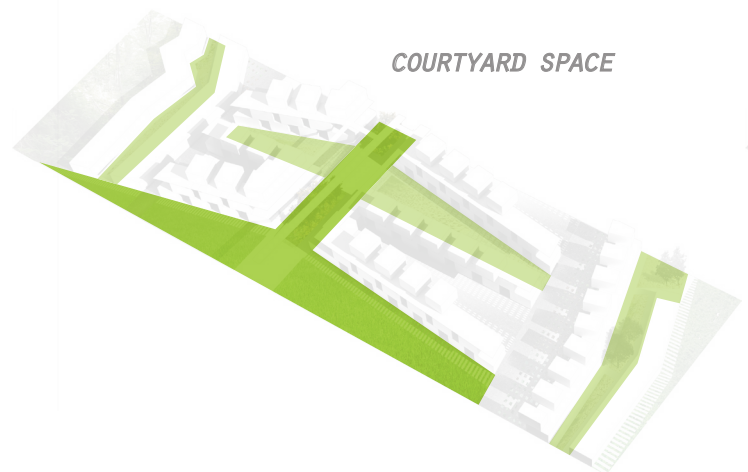


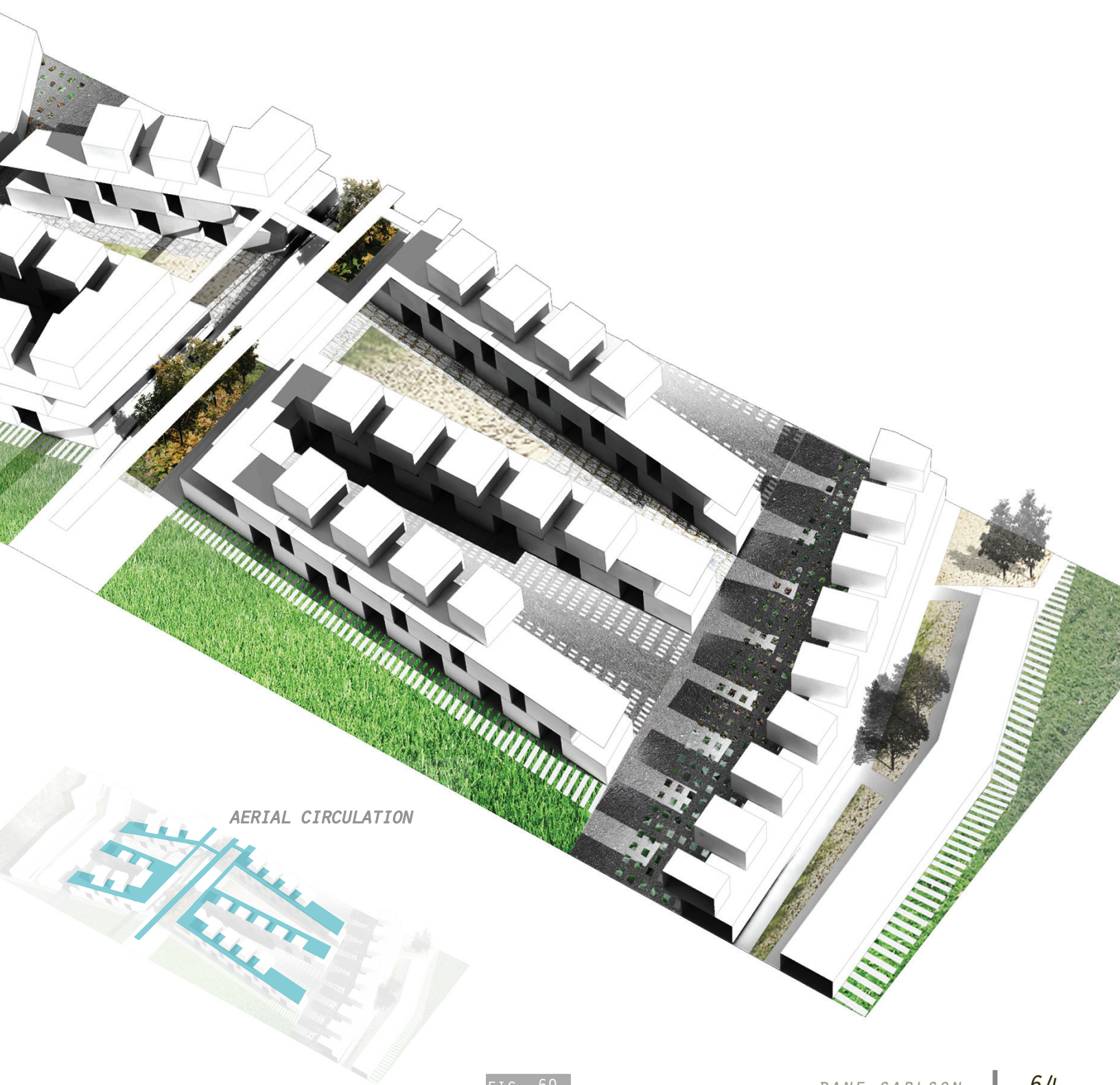
FIG. 61



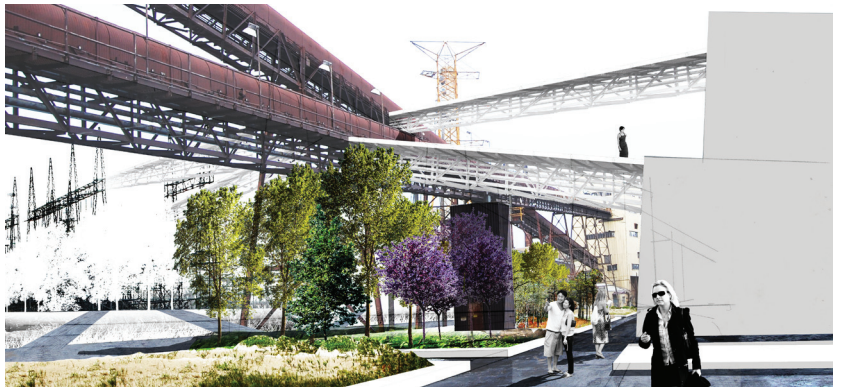
ACCESS AND PARKING



COURTYARD SPACE



AERIAL CIRCULATION



CONCLUSION

Michigan City and the NIPSCO generating station site are in need of a bold design solution. The site occupies a strategic location within the heart of the community and must be reclaimed for public use. This design proposal offers a solution to a multitude of problems and ultimately intends to recover this site for society and ecology.

To create a functional and beautiful solution to these problems, extensive research was pursued over the course of two semesters. Community development strategies, urban density, and walkability strategies result from research in community planning and urban design. Characteristics of coal plants and associated byproducts were researched to determine proper strategies for site treatment and reuse. Principally, ecological components of dune ecosystems were researched to provide a basis for development of a functional framework for ecological development.

Current practices in beach restoration are limited to sand nourishment and dune grass plantings; more innovative solutions are needed to create long-term solutions. Reuse of industrial materials and reintroduction of vegetation as shown in this proposal offer an innovative solution for solving the problem of migrating shorelines.

In opposition to current models of suburban development, the establishment of a beautiful, ecologically functional, and dense neighborhood creates a new model for midwestern development.

APPENDICES

SUPPLEMENTAL INTERVIEWS

NOEL PAVLOVIC, USGS

Through several phone interviews, I discussed various characteristics of dune formation and vegetation with Noel Pavlovic. Points noted and discussed during interviews included, but were not limited to, the following:

Foredunes are only colonized by cottonwoods if the dune contains sufficient moisture; for example, if it was once a wet spring.

North facing slopes of dunes are cooler and moister, and south facing slopes are more dry and host vegetative communities such as oak savannah.

The oak/hickory stage of dune development can begin without being preceded by a pine forest.

Little bluestem grass often begins to grow behind the first foredune.

If artificially introduced, pines must be planted inland on stabilized soil beyond the first dune strata.

Vegetation in intradunal wetlands varies based on lake level; dominant species include juncus balticus, horned bladderwort, clubmoss, lobelia, and st. johnswort.

As pines mature, oaks can invade (red oak, black oak, basswood, etc.)

While oak savannah has the potential to develop on south facing slopes, oak forests grow on north facing slopes.

TODD THOMPSON, IGS

Through several phone interviews, I discussed various characteristics of dune formation and vegetation with Todd Thompson. Points noted and discussed during interviews included, but were not limited to, the following:

Dune blowouts occur naturally and form parabolic dunes.

Dune blowout formations occur when strong onshore winds erode gaps in a foredune or series of ridges, allowing wind to blow through the gap and sweep sand inland.

Clay from a preglacial lake lies directly below the existing sand at approximately 579' above sea level.

The soil formation responsible for the formation of sandy beaches and dunes is known as the Tolleston Beach formation.

Typically, rainwater drops on dunes, seeps downward to the clay sheet, and runs into the lake. This is not possible, however, due to the barrier of the sheet pilings.

The Great Marsh area south of the site drains to Trail Creek so associated water does not flow through the site's potentially contaminated soils to reach the lake.

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(source: http://farm1.static.flickr.com/64/199589745_0a7f63dab5.jpg?v=0)

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(source: http://www.nps.gov/indu/historyculture/early_development.htm)

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(source: http://www.nps.gov/indu/historyculture/early_development.htm)

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(source: http://www.monon.monon.org/bygone_michcity/hoosierslide/01-28HoosierSlide-1908.jpg)

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(maps courtesy of LaPorte County Geographic Information Systems Office)

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(source: <http://cgtextures.com/login.php?&texid=47893&destination=texview.php?id=47893&PHPSESSID=gnru0ga8i9kc810frlma4u5in1>)

52 B: sand

(source: <http://cgtextures.com/login.php?&texid=32483&destination=texview.php?id=32483&PHPSESSID=gnru0ga8i9kc810frlma4u5in1>)

52 C: wooden slats

(source: <http://cgtextures.com/login.php?&texid=4788&destination=texview.php?id=4788&PHPSESSID=gnru0ga8i9kc810frlma4u5in1>)

52 D: wooden beam

(source: <http://cgtextures.com/login.php?&texid=39499&destination=texview.php?id=39499&PHPSESSID=gnru0ga8i9kc810frlma4u5in1>)

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(source: <http://cgtextures.com/login.php?&texid=4220&destination=texview.php?id=4220&PHPSESSID=gnru0ga8i9kc810frlma4u5in1>)

57 B: cobblestones

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57 C: wooden post

(source: <http://cgtextures.com/login.php?&texid=4774&destination=texview.php?id=4774&PHPSESSID=gnru0ga8i9kc810frlma4u5in1>)

57 D: sand

(source: <http://cgtextures.com/login.php?&texid=32483&destination=texview.php?id=32483&PHPSESSID=gnru0ga8i9kc810frlma4u5in1>)

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